

STUDY OF EVALUATION SCHEME (Ver 2.0)

of
COURSEWORK
for
Ph.D.PROGRAMME

(As approved by 9th Meeting of Academic Council held on 6th October 2023 Vide Agenda number 9.10
and 9th meeting of BOM dated 6th October 2023 Vide Agenda number 9.4.7)



Quantum University, Roorkee

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Roorkee-247167 UK, INDIA

*Approved.
Chancellor,
24/09/23.*

Vice Chancellor
Quantum University
Roorkee, India

M.H.



(Incompliance of Minimum Standards and Procedures for Award of M.Phil/Ph.D. Degree
Regulations, 2022 and subsequent directives)

Effective from 1st July 2023

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SCHEME OF EVALUATION

Course Work Ph.D. PROGRAMME

| S.NO. | COURSE CODE | SUBJECT | CREDITS | Hrs |
|-------|-------------|--|---------|-------|
| 1 | PD101 | Research Methodology-I: Problem Identifications, Formulations Hypothesis and Computer Applications | 3 | 45Hrs |
| 2 | PD102 | Research Methodology-II : Quantitative Methods, Measurement, Statistical Analysis and Report Writing | 3 | 45Hrs |
| 3 | PD171 | Research Methodology-III :Literature Survey | 3 | 45Hrs |
| 4 | PD104 | Research Methodology-IV: Research and Publication Ethics | 3 | 45Hrs |
| 5 | | Domain Specific Elective or MOOC | 4 | 60Hrs |

Research Methodology I to IV is compulsory courses for every Ph.D. Coursework student.

A Coursework student has to complete 16 credit courses to complete requirement of pre Ph.D. coursework.

The domain specific course either recommended by SRC or taken from list Electives which should in sync of the research Problem. The students may opt for MOOC course run by UGC recognized Platforms and as per university policy for MOOC. The MOOC need approval RAC and SRC of the student.








Syllabus for Course Work

Ph.D Programme

Course Name: - Research Methodology –I

Course Code: - PD 101

Objective: To familiarize the research scholar with the fundamentals of scientific research Course Contents:

1. Scientific Research: meaning and characteristics of scientific research, validity in research, phases/stages in research, types of research- qualitative, quantitative, experimental, exploratory, empirical, descriptive, ex- post facto, case studies, historical studies, philosophical studies, quasi experimental; ethical problems in research; constructs and variables- nature of construct and variables, concept of constructs, type of variables, continuous and categorical, constructs: observables and intervening variables; Review of literature- purpose of the review, sources of the review, preparation of index card for reviewing and abstracting

2. Problem Identification and Hypothesis Formation: problem- meaning and characteristics of a problem, types of problem, generality and specific of problem; hypothesis- meaning and characteristics of a good hypothesis, types of hypotheses, formulating a hypothesis, ways of stating a hypothesis; testing experimental hypothesis- standard error, test of significance, level of significance, degrees of freedom, errors in hypothesis-type I, type II errors

3. Sampling and Research Design: meaning and types of sampling: probability and non-probability sampling, methods of drawing samples, requisites of a good sampling method, sample size, sampling error; meaning and purpose of research design, types of research design, criteria of a good research design, basic principles of experimental design

4. Introduction to MS-Office: MS-WORD, MS-EXCEL, MATLAB, LATEX.

Suggested Readings:

1. Cooper & Schindler, Business Research Methods, Tata McGraw Hill.
2. Saunders, Research Methods for Business Students, Pearson Education.
3. Allen T Harrell, New Methods in Social Science Researchs, Praeger Publishers, New York
4. Beri, G.C., Statistics for Management, Tata MacGraw-Hill
5. Chandan J. S., Statistics for Business and Economics, Vikas Publications.
6. Broota, K.D., Experimental Designs in Behavioural Research, New Age International
7. Singh A. K., Test Measurement and Research Methods in Behaviours Sciences, Bharti Bhawan
8. Joyce Cox & Polly Urban, Microsoft Office, Galgotia Publishing
9. Sinha P.K., Computer Fundamentals, BPB Publishing.



M.H.

Course Name: - Research Methodology –II

Course Code: - PD 102

Objective: To gain familiarity about various data collection tools and techniques, data analysis and interpretation along with the application of computer and statistical software in research.

Course Contents:

1. Measurement and Scaling Techniques: Measurement in research, measurement scales sources of errors in measurement, tests of second measurement, techniques of developing measurement tools, meaning of scaling, scale classification bases, important scaling techniques, and scale construction techniques.

2. Data Collection, Processing and Analysis: Methods of data collection – primary data, secondary data; primary data collection – observation method, interview method, questionnaires, schedules, guideline for constructing questionnaires/schedules, secondary data collection of, selection of appropriate method of data collection; coding, editing and tabulation of data, charts and diagrams used in data analysis, bar and pie diagrams and their significance; measures of central tendency, measures of dispersion.

Correlation and regression analysis - meaning and uses, methods of calculation of coefficients and their analysis and implication sampling distribution, sampling schemes and sample sizes, confidence interval for the mean, t- statistic, z-statistic, confidence interval for the population variances, hypothesis testing, test of hypothesis for the population mean, population variance and ratio of two population variances; applications of z-test, t-test, f-test and chi-square test, association of attributes and techniques of testing, ANOVA 3. Report Writing: Meaning and significance of report writing, types of report, steps in writing report, layout of the research report, precaution in writing research report, developing thesis report, formatting, inside citations, references and bibliography, knowledge of computer, statistical software and their application, application of statistical tests/techniques through the use of statistical software like SPSS, scientific packages like LISREL, AMOS, and SYSTAT for documentation and report generation.

Suggested Readings:

1. Cooper & Schindler, Business Research Methods, Tata McGraw Hill.
2. Malhotra Naresh K., Marketing Research, Pearson Education
3. Power Analysis for experimental Research: A practical Guide for the Biological, Medical and Social Sciences by R. Barker Baushell, Yu-Fang Li Cambridge University Press
4. Chandan J. S., Statistics for Business and Economics, Vikas Publications
5. Broota, K.D., Experimental Designs in Behavioural Research, New Age International
6. Singh A. K., Test Measurement and Research Methods in Behaviours Sciences, Bharti Bhawan
7. Joyce Cox & Polly Urban, Microsoft Office, Galgotia Publishing
8. Sinha P.K., Computer Fundamentals, BPB Publishing.
9. Latex: A Document Preparation System, 2/E pearson low price edition by Lampport
10. MATLAB: An Introduction with Applications by Gilat Wiley India Pvt Ltd
11. Getting started with MATLAB by Rudra Pratap Oxford University Press



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Course Name: - Research Methodology –III

Course Code: - PD 171

Objective: The main objective of this course is to undertake a thorough review of available literature on the topic selected by the research scholar

Course Content

The research scholar will review the important studies conducted at the national and international level either by individuals or organizations including government agencies and present the methodology adopted and important findings emerged from these studies. Based on this review of literature the researcher will identify the research gaps existing in the available literature and thus justifying the need for the present study.

The researcher is supposed to follow the pattern adopted in the standard national and international research journals. However, as an illustration the pattern for reporting review of literature is as under:

Illustrated Example

Tiwari and Sinha (1971) gave productivity trends and factor compensation in Indian textiles industry for the period 1946-65 comprising of two sub-periods (1946- 1955 and 1956-1965). The marginal productivity of capital on an average for the industry as a whole is found to be lower in the sub- period (1946-55) and higher during (1956- 65). On the contrary, the estimates of the marginal productivity of labour again on average exhibit an actual decline from 2.9 percent to 2.5 percent.

Menon (1971) in his review article examines the concepts associated with measurement of productivity at various dimensions of output and input, which are the major elements involved in the exercise of measuring productivity.

Kumar, Anil and Khurana (2007) in their paper have examined trends in productivity of labour and capital in dairy industry in India during pre and post-reform periods. The results in the study conclude that labour productivity at national level has shown considerable improvement during post-reform period. But variations have been observed in case of growth rate of labour productivity at state-level. On the other hand, capital productivity has declined during post-reform period at national and state levels.

Kumar and Bala (2007) in their study on "An evaluation of the impact of economic reforms on the growth and productivity of Indian small scale sector" has concluded that economic reforms process initiated in the early nineties has had a downbeat impact on the growth and productivity of small scale sector.



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Research Director
Quantum University, Rohtak



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M. L.

Course Name: - Research Methodology –IV

Course Code: - PD 104

Introduction to Research, Ethics and Academic Honesty, Ethics in Writing, Academic Integrity: Research, Misconduct/Fabrication /Unethical Practices; Academic/Research: Falsification, Manipulation or Tempering of Data, Literature Review and Proper Use of E-Resources, Using Design thinking Methods to Avoid Plagiarism, Writing Quality Academic Publications: Challenges to avoid plagiarism, Scientific Reading, Cite and Write, Style Manuals and Bibliographies. Ex. APA, MLA, Chicago, IEEE,

Introduction to Reference Management Tools (RMT), Features and Functionalities of Anti-Plagiarism Software, Detection of Plagiarism by using Different Online Tools, Agencies and Organization dealing with plagiarism issues (eg. Retract/Deluze), Plagiarism Policies, Penalties and Consequences.

Introduction of Publication Ethics and its violations, Concept of Authorship, Concepts of Competing interests; Simultaneous submission, Types of Research fraud, Concept of Salami slicing, Concepts of conflict of interests

Suggested Reading:

1. Elsevier | Ethics in Research & Publication



N. Singh

M. I.

List of Domain Specific Electives

Department of Computer Science and Engineering
(Choose any one)

| Course Code | Title | Teaching Scheme |
|-------------|--|-----------------|
| PD 70101 | Optimization Techniques | 3-0-2 |
| PD 70102 | Machine Learning and Deep Learning | 3-0-2 |
| PD 70103 | Artificial Intelligence and Research Tools | 3-0-2 |
| PD 70104 | Computer Vision and AI | 3-0-2 |
| PD 70105 | Machine learning with Python Programming | 3-0-2 |

| Course Code- PD 70101 | Title: Optimization Techniques | L T P C 3 0 2 4 |
|---|---|-------------------------|
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | The objective of this course is to provide knowledge of basic optimization concepts and techniques, develop the ability to solve linear and nonlinear optimization problems, apply optimization methods in engineering applications, and introduce intelligent optimization techniques such as Genetic Algorithms and Particle Swarm Optimization. | |
| Expected Outcome | After completing this course, students will be able to formulate optimization problems mathematically, apply linear and nonlinear optimization techniques, solve constrained and unconstrained optimization problems, and use intelligent optimization methods for real-world engineering applications. | |
| Unit No. | | No. of hours (per Unit) |
| Unit I | Introduction to optimization | 8 |
| Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers. | | |
| Unit II | Linear Programming Problem | 8 |
| Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis. | | |
| Unit III | Single Variable Optimization Problems | 8 |
| Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method. | | |
| Unit IV | Multivariable and Constrained Optimization Techniques | 10 |
| Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve's pattern search method, Powell's conjugate direction method, Gradient based method, Cauchy's Steepest descent method, Newton's method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method | | |
| Unit V | Intelligent Optimization Techniques | 8 |
| Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP. | | |
| Text Books | <ol style="list-style-type: none"> S. S. Rao, Engineering Optimisation: Theory and Practice , Wiley, 2008. K. Deb, Optimization for Engineering design algorithms and Examples , Prentice Hall, 2 nd edition 2012. | |
| Reference Books | <ol style="list-style-type: none"> C.J. Ray, Optimum Design of Mechanical Elements , Wiley, 2007. R. Saravanan, Manufacturing Optimization through Intelligent Techniques , Taylor & Francis Publications, 2006. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning . Addison-Wesley Longman Publishing, 1989. | |
| E-Resource | NPTEL Optimization Methods Course Optimization Theory and Algorithms by IIT Madras | |



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| | 3. <u>Optimization from Fundamentals Course</u> 4. <u>SWAYAM Portal</u> |
| Mode of Evaluation | Internal and External |
| Recommendation by Board of Studies on | |
| Date of approval by the Academic Council | 06/10/2023 |

Course Outcome for PD 70101

| Unit-wise Course Outcome | Descriptions | BL Level | Employability (Emp)/ Skill(S)/ Entrepreneurship (Emt)/ None (Use , for more than One) |
|--------------------------|--|----------|---|
| CO1 | Understand the fundamentals of optimization problems, objective functions, constraints, and classical optimization techniques. | 2 | Emp, S |
| CO2 | Apply linear programming methods such as Simplex, Big-M, and Duality techniques to solve optimization problems. | 3 | Emp, S |
| CO3 | Analyze and solve single variable optimization problems using search and gradient-based methods. | 4 | Emp, S |
| CO4 | Apply multivariable and constrained optimization techniques for engineering problem solving. | 3 | Emp, S |
| CO5 | Understand and implement intelligent optimization techniques such as Genetic Algorithm, PSO, and Genetic Programming. | 3 | Emp, S, Emt |

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|-----------------------|--|------------------|
| Course Code: PD 70102 | Title: Machine Learning and Deep Learning | LT PC 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | This course introduces fundamental concepts of Machine Learning and Deep Learning, including supervised, unsupervised, and reinforcement learning techniques. It enables scholars to design intelligent models using modern frameworks, provides practical exposure to neural networks and deep learning architectures, and explores current AI research trends and interdisciplinary real-world applications. | |
| Expected Outcome | <p>After successful completion of the course, the scholar will be able to:</p> <ul style="list-style-type: none"> Understand mathematical foundations and concepts of Machine Learning and Deep Learning. Apply suitable machine learning algorithms for classification, regression, and clustering problems. Design and train neural network models using deep learning frameworks. Analyze model performance using evaluation metrics and optimization techniques. <p>1. Read, understand, and implement research-oriented ML/DL</p> | |



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| Unit No. | Unit Title | No. of hours (per Unit) |
|---|--|-------------------------|
| Unit I | Introduction to Machine Learning | 8 |
| Introduction to Artificial Intelligence, Machine Learning, and Deep Learning; Types of Learning – Supervised, Unsupervised, Reinforcement Learning; Applications of ML in Healthcare, Agriculture, Finance, IoT, and Smart Systems; Data Preprocessing, Feature Engineering, Training and Testing, Bias-Variance Tradeoff | | |
| Unit II | Supervised Learning Techniques | 10 |
| Linear Regression, Logistic Regression, k-Nearest Neighbors (KNN), Naïve Bayes, Decision Trees, Random Forest, Support Vector Machine (SVM); Model Evaluation Metrics – Accuracy, Precision, Recall, F1-score, ROC Curve; Cross Validation and Hyperparameter Tuning | | |
| Unit III | Unsupervised and Reinforcement Learning | 10 |
| Clustering Techniques – K-Means, Hierarchical Clustering, DBSCAN; Dimensionality Reduction – PCA, t-SNE; Association Rule Mining; Basics of Reinforcement Learning – Agent, Environment, Reward, Q-Learning | | |
| Unit IV | Fundamentals of Deep Learning | 8 |
| Artificial Neural Networks (ANN), Perceptron Model, Activation Functions, Loss Functions, Backpropagation, Gradient Descent, Optimization Techniques, Regularization Methods, Introduction to TensorFlow/PyTorch/Keras | | |
| Unit V | Advanced Deep Learning and Research Applications | 8 |
| Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), LSTM, Transfer Learning, Autoencoders, Generative AI Basics, Explainable AI (XAI), Ethical Issues in AI, Research Trends and Case Studies | | |
| Text Books | <ol style="list-style-type: none"> 1. Pattern Recognition and Machine Learning, Christopher M. Bishop, <i>Pattern Recognition and Machine Learning</i>, Springer, 2006. 2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, <i>Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems</i>, 3rd Edition, O'Reilly Media, 2022. 3. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, <i>Deep Learning</i>, MIT Press, 2016. | |
| Reference Books | <ol style="list-style-type: none"> 1. Machine Learning, Tom M. Mitchell, <i>Machine Learning</i>, McGraw-Hill Education, 1997. 2. Deep Learning with Python, François Chollet, <i>Deep Learning with Python</i>, 2nd Edition, Manning Publications, 2021. | |
| Mode of Evaluation | | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

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| Course Code-PD 70103 | Title: Artificial Intelligence and Research Tools | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | This course introduces the fundamental concepts and applications of Artificial Intelligence while familiarizing scholars with modern AI tools and research methodologies. It develops skills in literature review, academic writing, and scientific publishing, provides hands-on exposure to AI-based research tools, | |



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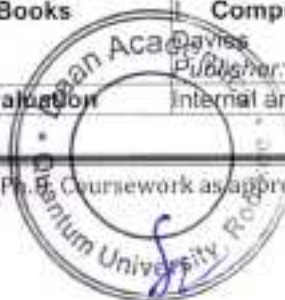
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| | and enables scholars to conduct ethical, reproducible, and impactful research in interdisciplinary domains. | |
| Expected Outcome | <ul style="list-style-type: none"> • Understand core concepts and techniques of Artificial Intelligence. • Use AI tools for research, data analysis, academic writing, and presentations • Conduct systematic literature reviews and identify research gaps. • Apply research methodologies and statistical techniques in scientific studies. • Prepare quality research papers, reports, and thesis documents using modern research tools. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Introduction to Artificial Intelligence | 8 |
| Introduction to AI, History and Evolution of AI, Types of AI, Intelligent Agents, Search Techniques, Knowledge Representation, Applications of AI in Healthcare, Education, Agriculture, Industry, Robotics, and Smart Systems; Overview of Machine Learning, Deep Learning, Natural Language Processing, Computer Vision, and Generative AI; Ethical AI and Responsible AI. | | |
| Unit II | Machine Learning and Deep Learning Fundamentals | 8 |
| Introduction to Machine Learning, Types of Learning – Supervised, Unsupervised, and Reinforcement Learning; Regression and Classification Concepts; Neural Networks, Perceptron Model, Activation Functions; Introduction to Deep Learning Architectures – CNN, RNN, LSTM, AI Model Training and Evaluation Basics. | | |
| Unit III | Generative AI and AI Research Tools | 10 |
| Introduction to Generative AI and Large Language Models (LLMs); Prompt Engineering Techniques; AI Tools for Research and Productivity – ChatGPT, Gemini, Grammarly, QuillBot, Elicit, Consensus, Connected Papers, Scite; AI-assisted Literature Review, Citation and Reference Management using Mendeley and Zotero. | | |
| Unit IV | AI Applications and Intelligent Systems | 10 |
| AI Applications in Smart Manufacturing, Healthcare, Finance, Cybersecurity, Agriculture, Education, and IoT; Recommender Systems, Chatbots, Autonomous Systems, AI in Data Analytics and Decision Making; Cloud AI Platforms and AI-as-a-Service; Edge AI and Explainable AI (XAI). | | |
| Unit V | AI Ethics, Research Trends, and Scientific Communication | 8 |
| Research Ethics in AI, Bias in AI Systems, Privacy and Security Issues, Intellectual Property Rights (IPR), Plagiarism and AI-generated Content; AI in Scientific Publishing and Research Automation; Emerging Trends – Agentic AI, Multimodal AI, AI for Science, Federated Learning, Digital Twins, and Human-AI Collaboration; Scientific Writing using Overleaf and LaTeX. | | |
| Text Books | <ol style="list-style-type: none"> 1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i>, 4th Edition, Pearson Education, 2021. 2. Deep Learning Ian Goodfellow, Yoshua Bengio, and Aaron Courville, <i>Deep Learning</i>. MIT Press, 2016. 3. Research Methodology, C. R. Kothari and Gaurav Garg, <i>Research Methodology: Methods and Techniques</i>, 4th Edition, New Age International Publishers, 2019. | |
| Reference Books | <ol style="list-style-type: none"> 1. The Craft of Research, Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, Joseph Bizup, and William T. FitzGerald, <i>The Craft of Research</i>, 4th Edition, University of Chicago Press, 2016. 2. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, and Peter Gedeck, <i>Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python</i>, 2nd Edition, O'Reilly Media, 2020. | |
| Mode of Evaluation | | |
| Recommendation by Board of Studies on Academic Council | | |
| Date of approval by the Academic Council | 06/10/2023 | |



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| Course Code- PD 70104 | Title: Computer Vision and AI | LTPC 3024 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | <ul style="list-style-type: none"> To understand the fundamentals of Computer Vision, Artificial Intelligence and digital image processing. To study image enhancement, segmentation, feature extraction and object recognition techniques. To develop the ability to apply AI and deep learning methods in real-world vision applications. | |
| Expected Outcome | <ul style="list-style-type: none"> Apply image processing and Computer Vision techniques for image analysis and recognition tasks. Use AI and machine learning methods for object detection and classification. Develop basic Computer Vision applications for real-world problem solving. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Fundamentals of Computer Vision and Image Processing | 8 |
| Introduction to Computer Vision and AI ,Digital image representation and image formation ,Image enhancement techniques Point processing and piece-wise linear transformations ,Histogram equalization and histogram specification ,Bit plane slicing and image smoothing ,Applications of Computer Vision in AI systems | | |
| Unit II | Image Restoration and Edge Detection | 10 |
| Image degradation and restoration models ,Noise models: Gaussian, Rayleigh, Poisson and Salt & Pepper noise ,Spatial domain filtering ,Mean, geometric and harmonic filters ,Inverse and Wiener filtering ,Edge detection techniques ,Roberts, Prewitt and Sobel operators ,Laplacian and LoG operators | | |
| Unit III | Image Segmentation and Feature Extraction | 8 |
| Image segmentation methods ,Thresholding: Global, Local and Adaptive ,Region growing, split and merge techniques Clustering methods: K-Means and Fuzzy C-Means ,Contour and graph-based segmentation ,Feature extraction techniques Spatial and transform-based features ,Texture features: GLCM and Gabor filters ,Shape, color and statistical features | | |
| Unit IV | Object Representation and Description | 10 |
| Boundary representation techniques ,Chain codes, polygon approximation and signatures ,Skeleton representation Boundary and region description ,Shape numbers and Fourier descriptors ,Texture and moment-based descriptors Region representation methods,Quad tree, run length encoding and projections | | |
| Unit V | Object Recognition and AI Applications | 10 |
| Pattern recognition and pattern classification ,Decision theoretic and structural approaches for recognition ,Introduction to machine learning in Computer Vision ,AI-based object detection and recognition systems ,Applications: Face recognition, medical imaging, autonomous systems and surveillance | | |
| Text Books | 1. Computer Vision: Algorithms and Applications — Richard Szeliski Publisher: Springer. 2. Computer Vision and Image Processing — Adrian Low Publisher: McGraw-Hill Education | |
| Reference Books | Computer Vision: Principles, Algorithms, Applications, Learning — E. R. Davies Publisher: Academic Press | |
| Mode of Evaluation | Internal and External Examinations | |



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| Recommendation by Board of Studies on | |
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| Course Code:PD 70105 | Title: Machine learning with Python Programming | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Basic Mathematics and Programming Knowledge | |
| Objectives | This course introduces the fundamental concepts of Machine Learning using Python programming. It enables scholars to understand data preprocessing, supervised and unsupervised learning techniques, and model evaluation methods. The course also provides practical exposure to Python-based machine learning libraries and explores real-world AI applications and research trends. | |
| Expected Outcome | After completion of the course, scholars will be able to: <ul style="list-style-type: none"> • Understand the basic concepts and workflow of Machine Learning. • Apply Python libraries for data preprocessing, visualization, and model development. • Implement supervised and unsupervised learning algorithms using Python. • Evaluate and optimize machine learning models for real-world applications. • Explore advanced trends and applications of Machine Learning in interdisciplinary domains. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Introduction to Machine Learning and Python | 10 |
| Introduction to Artificial Intelligence, Machine Learning, and Data Science; Types of Machine Learning – Supervised, Unsupervised, and Reinforcement Learning; Introduction to Python for ML; Python Libraries – NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn; Data Collection, Data Cleaning, and Data Preprocessing Techniques. | | |
| Unit II | Supervised Learning Techniques | 10 |
| Regression and Classification Concepts; Linear Regression, Logistic Regression, k-Nearest Neighbors (KNN), Decision Trees, Random Forest, Naïve Bayes, Support Vector Machine (SVM); Training and Testing Datasets; Performance Metrics – Accuracy, Precision, Recall, F1-Score, Confusion Matrix. | | |
| Unit III | Unsupervised Learning Techniques | 10 |
| Introduction to Clustering and Dimensionality Reduction; K-Means Clustering, Hierarchical Clustering, DBSCAN; Principal Component Analysis (PCA); Association Rule Mining; Data Visualization and Pattern Analysis using Python Libraries. | | |
| Unit IV | Python Libraries and Machine Learning Implementation | 8 |
| Introduction to Scikit-learn Library; Data Handling using Pandas and NumPy; Data Visualization using Matplotlib and Seaborn; Building Machine Learning Models using Python; Model Training, Testing, and Evaluation; Cross Validation and Hyperparameter Tuning, Pipeline Creation using Scikit-learn. | | |
| Unit V | Advanced Python-Based Deep Learning Applications | 8 |



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Introduction to TensorFlow and Keras; Neural Networks using Python; Deep Learning Model Development; Image Classification and Text Analysis Basics; Machine Learning Model Deployment Basics; Case Studies and Real-World Applications using Python

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|---|---|
| Text Books | <ol style="list-style-type: none"> Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, <i>Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems</i>, 3rd Edition, O'Reilly Media, 2022. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, <i>Python Machine Learning: Machine Learning and Deep Learning with Python, Scikit-learn, and TensorFlow</i>, 3rd Edition, Packt Publishing, 2019. Introduction to Machine Learning with Python, Andreas C. Müller and Sarah Guido, <i>Introduction to Machine Learning with Python: A Guide for Data Scientists</i>, O'Reilly Media, 2016. |
| Reference Books | <ol style="list-style-type: none"> Pattern Recognition and Machine Learning, Christopher M. Bishop, <i>Pattern Recognition and Machine Learning</i>, Springer, 2006. Machine Learning, Tom M. Mitchell, <i>Machine Learning</i>, McGraw-Hill Education, 1997. Deep Learning with Python, François Chollet, <i>Deep Learning with Python</i>, 2nd Edition, Manning Publications, 2021. |
| Mode of Evaluation | |
| Recommendation by Board of Studies on | |
| Date of approval by the Academic Council | 06/10/2023 |

Department of Mechanical Engineering
(Choose any one)

| Course Code | Title | Teaching Scheme |
|-------------|--|-----------------|
| PD 70201 | Advanced Computational Methods in Mechanical Engineering | 3-0-2 |
| PD 70202 | Advanced Manufacturing Technologies | 3-0-2 |
| PD 70203 | Renewable Energy Systems and Sustainability | 3-0-2 |

Course Code- PD 70201 –Advanced Computational Methods in Mechanical Engineering

| L | T | P | C | Version No. |
|---|---|---|---|-------------|
| 3 | 0 | 2 | 4 | 2.0 |

Course Prerequisites: Engineering Mathematics, Numerical Methods

Objectives: To provide advanced knowledge of computational techniques, numerical analysis, finite element methods,

Computational fluid dynamics and optimization tools used in mechanical engineering research and industrial applications.

| Unit No. | Unit Title | No. of Hours | Contents |
|----------|---|--------------|---|
| Unit I | Numerical-Methods and Mathematical Modeling | 10 | Errors and approximations, numerical solution of linear and nonlinear equations, interpolation and curve fitting, numerical differentiation and integration, mathematical |



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| | | | modeling of mechanical systems. Taylor series expansion, Newton-Raphson method, Lagrange interpolation, trapezoidal and Simpson's rule, engineering model formulation. |
| Unit II | Finite Element Methods (FEM) | 10 | Introduction to FEM, element types and shape functions, one-dimensional and two-dimensional finite element analysis, structural and thermal applications. Mesh generation, stiffness matrix formulation, boundary conditions, thermal stress analysis, convergence analysis. |
| Unit III | Computational Fluid Dynamics (CFD) | 10 | Governing equations of fluid flow, discretization methods, finite volume method, turbulence models and boundary conditions. Navier-Stokes equations, SIMPLE algorithm, meshing techniques, turbulence modeling, CFD preprocessing and postprocessing. |
| Unit IV | Optimization and Simulation Techniques | 8 | Engineering optimization methods, linear and nonlinear optimization, simulation techniques and Monte Carlo methods. Genetic algorithms, response surface methodology, design optimization, system simulation, probabilistic analysis. |
| Unit V | Advanced Computational Applications | 8 | Multiphysics simulations, AI and machine learning in computational mechanics, high-performance computing applications. Digital twins, coupled field analysis, neural networks, industrial case studies, parallel computing. |

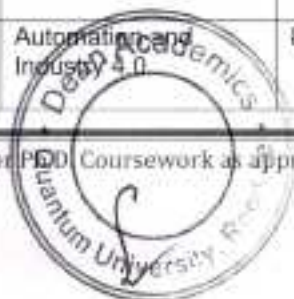
Course Code- PD 70202 –Advanced Manufacturing Technologies

| L | T | P | C | Version No. |
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| 3 | 0 | 2 | 4 | 2.0 |

Course Prerequisites: Manufacturing Processes, Production Engineering

Objectives: To provide understanding of advanced manufacturing systems, smart manufacturing technologies, automation, additive manufacturing, and sustainable manufacturing practices used in modern industries.

| Unit No. | Unit Title | No. of Hours | Contents |
|-----------------|--|--------------|--|
| Unit I | Modern Manufacturing Systems | 8 | Evolution of manufacturing systems, CIM, FMS, lean manufacturing principles, smart manufacturing concepts. Agile manufacturing, Just-In-Time systems; automation hierarchy, manufacturing integration, production planning. |
| Unit II | Additive Manufacturing and Rapid Prototyping | 10 | Fundamentals of additive manufacturing, 3D printing technologies, rapid prototyping techniques. Stereolithography, fused deposition modeling, selective laser sintering, design for AM, industrial applications. |
| Unit III | Advanced Machining Processes | 10 | Non-traditional machining methods including EDM, ECM, laser beam machining and water jet machining. Ultrasonic machining, micromachining, nanomachining, process parameters, surface integrity. |
| Unit IV | Automation and Industry 4.0 | 8 | Industrial robotics, automation systems, sensors and IoT in manufacturing. Cyber-physical systems, AI in manufacturing, smart |



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| | | | sensors, digital manufacturing, robotic process automation. |
| Unit V | Sustainable and Emerging Manufacturing Technologies | 8 | Green manufacturing, sustainable manufacturing systems, energy-efficient manufacturing, Recycling technologies, nano-manufacturing, bio-manufacturing, carbon-neutral manufacturing, future trends. |

Course Code- PD 70203- Renewable Energy Systems and Sustainability

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| L | T | P | C | Version No. |
| 3 | 0 | 2 | 4 | 2.0 |

Course Prerequisites: Thermodynamics, Heat Transfer

Objectives: To provide understanding of renewable energy technologies, sustainable energy systems, energy management, and environmental impacts associated with energy generation and utilization.

| Unit No. | Unit Title | No. of Hours | Contents |
|-----------------|--|--------------|--|
| Unit I | Fundamentals of Renewable Energy | 8 | Energy resources and sustainability, global energy scenario, environmental impacts and energy conversion principles. Conventional vs renewable energy, climate change, energy policies, sustainable development goals. |
| Unit II | Solar and Wind Energy Systems | 10 | Solar thermal systems, photovoltaic systems, wind energy fundamentals and wind turbine technologies. Solar collectors, MPPT techniques, wind farm analysis, turbine efficiency, hybrid systems. |
| Unit III | Bioenergy and Hybrid Renewable Systems | 10 | Biomass energy conversion, biogas and biofuels, geothermal and ocean energy systems. Anaerobic digestion, biodiesel production, tidal energy, hybrid renewable integration, waste-to-energy systems. |
| Unit IV | Energy Storage and Energy Management | 8 | Energy storage technologies, batteries and fuel cells, smart grids and energy auditing. Hydrogen storage, lithium-ion batteries, demand-side management, energy conservation techniques. |
| Unit V | Sustainability and Emerging Technologies | 8 | Sustainable development principles, life cycle assessment, carbon footprint analysis. AI and IoT in energy systems, green buildings, smart cities, future sustainable technologies. |

Department of Electronics and Communication Engineering
(Choose any one)

| Course Code | Title | Teaching Scheme |
|-------------|---|-----------------|
| PD 70301 | Solid State Device Modeling & Nanoelectronics and CMOS VLSI | 3-0-2 |
| PD 70302 | Organic Electronics: Materials and Devices | 3-0-2 |
| PD 70303 | Introduction to Quantum Engineering / Spin-Based Computing | 3-0-2 |

Syllabus for Ph.D. Coursework as approved by Academic Council 06/10/2023

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| Course Code- PD 70301 | Title: Solid State Device Modeling, Nanoelectronics and CMOS VLSI | L T P C |
| | | 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Foundations of Semiconductor Devices, Digital VLSI Circuits | |
| Objectives | To provide seamless, rigorous path from the mathematical modeling of solid-state device physics to nanoscale multi-gate CMOS circuit integration. This course balances fundamental semi-classical and quantum transport equations with structural scaling architectures (FinFETs, Nanosheets), advanced interconnect design, and emerging non-volatile memories for hardware accelerators. | |
| Course Outcome | Upon successful completion of the course, students will be able to: <ul style="list-style-type: none"> • Develop transport equations and compact parameters for advanced submicron transistor modeling • Assess short-channel degradation (DIBL, subthreshold swing) in sub-10nm logic gates • Optimize 3D multi-gate architectures (FinFETs, Nanosheets) based on electrostatic and parasitic trade-offs. • Mitigate nanoscale reliability failures (NBTI, HCI) and fabrication process variations (RDF, LER). • Evaluate post-Silicon channels (2D materials, CNTs) and alternative low-resistance interconnects (Co, Ru). • Design memristive crossbar memories optimized for analog CMOS compute-in-memory pipelines. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Carrier Transport & Drift-Diffusion | 10 |
| Moments of Boltzmann Transport Equation (BTE); Drift-Diffusion equations; numerical boundary conditions for Poisson-continuity solvers; hydrodynamic hot-carrier transport models. | | |
| Unit II | Compact Modeling & Nanoscale CMOS Scaling | 10 |
| Surface-potential vs. charge-based modeling paradigms; compact modeling mechanics (BSIM architecture); short-channel effects (SCEs), DIBL, and subthreshold swing limits in sub-10nm CMOS. | | |
| Unit III | Multi-Gate CMOS VLSI Architectures | 10 |
| Electrostatics and structural layout of FinFETs, Gate-All-Around (GAA) Nanowires, and Nanosheets; quantum confinement effects on threshold voltage (ΔV_{th} bounce); 3D parasitic capacitance extraction. | | |
| Unit IV | Advanced CMOS Materials & Reliability | 8 |
| High-SkSi/Metal Gate (HKMG) engineering; CMOS VLSI reliability modes: NBTI, HCI, and TDDB; process variability modeling (Random Dopant Fluctuations, Line-Edge Roughness). | | |
| Unit V | Post-Silicon CMOS & Emerging Paradigms | 8 |
| Alternate channels (SiGe, 2D materials like MoS_2); scaling limits of Copper vs. Cobalt interconnects; monolithic 3D IC integration; memristive crossbars for analog CMOS compute-in-memory. | | |
| Text Books | <ol style="list-style-type: none"> 1. Y. Taur and T. H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press. (The gold standard for nanoscale CMOS electrostatics). 2. S. M. Sze and K. N. Kwok, Physics of Semiconductor Devices, Wiley-Interscience. (The ultimate device physics blueprint). 3. Arora, MOSFET Models for VLSI Circuit Simulation: Theory and Practice, Springer. (Essential for compact modeling and BSIM formulations). | |
| Reference Books | <ol style="list-style-type: none"> 1. Mark Lundstrom, Fundamentals of Carrier Transport, Cambridge University Press. (Excellent for the Boltzmann Transport Equation). 2. Supriyo Datta, Quantum Transport: Atom to Transistor, Cambridge University | |

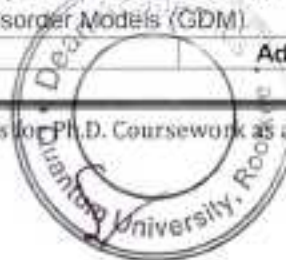


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| | Press. (The definitive guide for NEGF and ballistic transport). |
| | 3. Y. S. Chauhan, D. D. Lu, S. Venugopalan, and C. Hu, FinFET Modeling for IC Simulation: Theory to Practice, Academic Press. |
| E-Resources | NPTEL: Advanced VLSI Design / Nanoelectronics: Devices and Materials (IIT Bombay/IIT Madras). nanoHUB.org: Online simulation tools for self-consistent Schrödinger-Poisson and NEGF layouts. IEEE Xplore: IEEE Transactions on Electron Devices (T-ED) and IEEE Electron Device Letters (EDL). |
| Mode of Evaluation | Internal and External Examinations |
| Recommendation by Board of Studies on | |
| Date of approval by the Academic Council | 06/10/2023 |

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| PD 70302 | Title: Organic Electronics: Materials and Devices | L T P C3 02 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Solid State Physics, Introduction to Material Science | |
| Objectives | To deliver a comprehensive understanding of molecular orbital physics, disordered transport mechanics, and structural device architectures required to engineer high-efficiency flexible, wearable, and bio-compatible optoelectronic nodes. | |
| Course Outcome | Upon successful completion of the course, students will be able to: <ul style="list-style-type: none"> • Formulate mathematical statements for non-band carrier transport mechanisms (VRH, SCLC) in molecular systems. • Analyze excitonic spin statistics to engineer high-efficiency luminescence configurations in thin-film structures. • Optimize architectural parameters to overcome injection and collection losses at organic donor-acceptor junctions. • Isolate parasitic contact resistance and interfacial traps from raw organic transistor measurement metrics. • Design structural layouts and ink formulations for printed, flexible sensors under mechanical load constraints. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Quantum Chemistry, Orbitals & Exciton Physics | 10 |
| | Molecular orbital theory, s and p hybridization, π -conjugation and delocalized states; HOMO-LUMO levels, optical vs. transport bandgaps; Frenkel vs Wannier-Mott excitons, singlet and triplet spin statistics, exciton binding energies, diffusion dynamics, and radiative/non-radiative decay pathways. | |
| Unit II | Disordered Charge Transport Models | 10 |
| | Breakdown of conventional band transport, Anderson localization, polaron formation, and self-trapping; Variable-Range Hopping (VRH) models (Mott and Miller-Abrahams formalisms); Space-Charge-Limited Conduction (SCLC) under trap-free and exponential trap states; Poole-Frenkel field-dependent mobility and Gaussian Disorder Models (GDM). | |
| Unit III | Advanced Organic Optoelectronics [OLEDs & OPVs] | 8 |

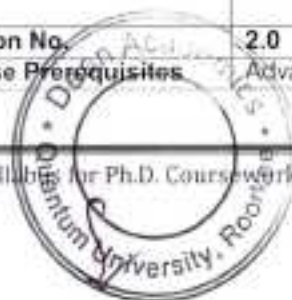


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| OLED operation physics, charge injection barriers, heterojunction optimization, internal vs. external quantum efficiency (SQE/EQE), and triplet harvesting mechanism (Phosphorescence, Thermally Activated Delayed Fluorescence [TADF]); Bulk Heterojunction (BHJ) organic solar cells, donor-acceptor interfaces, geminate vs. non-geminate recombination, and fill-factor (SFF) optimization. | | |
| Unit IV | Organic Transistors [OFETs] & Interface Characterization | 8 |
| OFET structural topologies (top/bottom gate/contacts), accumulation layer electrostatics, and charge-injection kinetics; parameter extraction protocols (field-effect mobility, threshold shifts, bias-stress instability); contact resistance modeling via Transmission Line Method (TLM); morphology profiling using Grazing-Incidence Wide-Angle X-ray Scattering (GIWAXS) and AFM. | | |
| Unit V | Flex-Mechanical Hardware, Printing & Bio-Interfaces | 8 |
| Flexible polymeric substrates (PET, PEN, Polyimide, Elastomers); mechanical strain engineering, neutral-axis positioning, and buckling/wrinkling mechanics; printing paradigms (inkjet, gravure, roll-to-roll micro-patterning); chemically transient/biodegradable electronics, and biocompatible interfaces for electrophysiological tissue/neural signal tracking. | | |
| Text Books | <ol style="list-style-type: none"> 1. Wolfgang Brütting and Chihaya Adachi, Physics of Organic Semiconductors, Wiley-VCH. (Comprehensive coverage of transport and exciton physics). 2. Franky So, Organic Electronics: Materials, Processing, Devices and Applications, CRC Press. (Excellent for manufacturing and structural topologies). 3. Zhenan Bao and Jiewei Jie, Organic Field-Effect Transistors, CRC Press. (The benchmark book for OFET parameters and interfaces). | |
| Reference Books | <ol style="list-style-type: none"> 1. Heinz Bässler and Anna Köhler, Electronic Processes in Organic Semiconductors: An Introduction, Wiley-VCH. (Deep mathematical focus on Gaussian Disorder Models). 2. William R. Salaneck, Conjugated Polymer and Molecular Interfaces, CRC Press. 3. Selected Review Literature: High-impact tutorial papers from Nature Materials and Advanced Materials on flexible strain engineering. | |
| E-Resources | <p>NPTEL / SWAYAM: Specialized modules on Plastic Electronics or Advanced Materials Chemistry.</p> <p>MIT OpenCourseWare: Molecular structures and polymer engineering sequences.</p> <p>IEEE Xplore / Wiley Online Library: IEEE Journal of the Electron Devices Society and Advanced Electronic Materials.</p> | |
| Mode of Evaluation | Internal and External Examinations | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

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| PD 70303 | Title: Introduction to Quantum Engineering & Spin-Based Computing | LTP C3024 |
| Version No. | 2.0 | |
| Course Prerequisites | Advanced Linear Algebra, Foundations of Solid State Physics | |




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| Objectives | To seamlessly bridge abstract quantum computation mechanics with experimental solid-state device platforms, providing the toolset to build cryogenic quantum hardware, non-volatile memories, and spin-based neuromorphic arrays. | |
| Course Outcome | Upon successful completion of the course, students will be able to: <ul style="list-style-type: none"> • Mathematicalize qubit states, coherent manipulations, and decoherence timelines using density matrices. • Evaluate the hardware trade-offs between superconducting transmon platforms and semiconductor quantum dots. • Calculate spin polarization indices and tunneling magnetoresistance parameters across layered heterostructures. • Simulate the Landau-Lifshitz-Gilbert (LLG) equation to resolve current-driven magnetization switching speeds. • Design spin-torque memory structures and skyrmion-based logic paths for bio-inspired neuromorphic acceleration. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Quantum Information Foundations & Qubit Dynamics | 8 |
| Hilbert spaces, Dirac notation, density matrix representation of pure and mixed states; Qubit concept, state superposition mapping on the Bloch Sphere; multi-qubit systems, tensor products, quantum entanglement, Bell states, and No-Cloning Theorem; open quantum systems, decoherence pathways, and phase relaxation lifetimes (T_1 thermal and T_2 dephasing times). | | |
| Unit II | Solid-State Cryogenic Qubit Platforms | 10 |
| Josephson junction electrostatics, Cooper pair box, phase/flux/charge qubit variations, and modern Transmon architecture designs; semiconductor quantum dots, electrostatic gate confinement, Coulomb blockade regimes, single-electron tunneling control, and Pauli spin blockade initialization/readout; cryo-CMOS interface electronics and thermal scaling limits. | | |
| Unit III | Spin Transport, GMR & Coherent Tunneling | 8 |
| Quantum mechanics of magnetism, spin angular momentum, exchange interactions, and Heisenberg Hamiltonian; relativistic Spin-Orbit Coupling (SOC), spin-polarized current injection, spin diffusion length, and spin-relaxation mechanics; Giant Magnetoresistance (GMR) and Tunneling Magnetoresistance (TMR) in Magnetic Tunnel Junctions (MTJs); Julliere's model and coherent tunneling through MgO barriers. | | |
| Unit IV | LLG Dynamics, STT & SOT MRAM Engineering | 8 |
| Magnetization trajectory modeling via the Landau-Lifshitz-Gilbert (LLG) equation with Slonczewski spin-torque terms; Spin-Transfer Torque (STT) mechanics, critical switching current density equations, and thermal stability factors (Δ); Spin-Orbit Torque (SOT) via the Spin Hall Effect (SHE) and Rashba effect; design of multi-terminal non-volatile MRAM cache architectures. | | |
| Unit V | Spin Logic, Magnetic Textures & Neuromorphic Networks | 8 |
| Spin-wave propagation, spin-wave interference logic gates, and All-Spin Logic (ASL) frameworks; physics and electrical manipulation of topological magnetic configurations: Magnetic Domain Walls and Skyrmions; pinning/depinning models, and utilizing skyrmion/domain-wall displacement to implement artificial hardware synapses and stochastic computing nodes. | | |
| Text Books | <ol style="list-style-type: none"> 1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press. (The absolute foundation for qubit mathematics). 2. Supriyo Bandyopadhyay and Marc Cahay, Introduction to Spintronics, CRC Press. (Superb for spin transport and GMR/TMR dynamics). 3. Evgeny Y. Tsybmal and Igor Žutić, Handbook of Spintronics, Springer. (Comprehensive review of hardware-level MRAM and textures). | |
| Reference Books | <ol style="list-style-type: none"> 1. Thomas D. Ladd et al., Quantum Computing Hardware, Nature Review Paper Sequence / Textbook compilations. 2. S. Maekawa, Concepts in Spin Electronics, Oxford University Press. (Advanced coverage of the LLG equation and Spin Hall Effects). 3. Thomas Mikolajick, Ferroelectrics for Microelectronics, Wiley. (Crucial for understanding FeFET quantum behaviors). | |

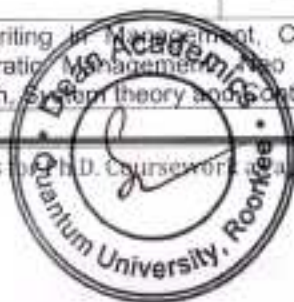


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| E-Resources | <p>SWAYAM / NPTEL: Quantum Information and Computing (IIT Madras/IIT Kanpur) / Spintronics lectures.</p> <p>IBM Quantum Learning / Qiskit Ecosystem: Direct cloud access to physical superconducting qubit configurations and documentation.</p> <p>IEEE Magnetics Society: IEEE Transactions on Magnetics and IEEE Magnetics Letters.</p> |
| Mode of Evaluation | Internal and External Examinations |
| Recommendation by Board of Studies on | |
| Date of approval by the Academic Council | 06/10/2023 |

Department of Business and Management
(Choose any one)

| Course Code | Title | Teaching Scheme |
|-------------|--|-----------------|
| PD 70401 | Management Philosophy and Practices | 4-0-0 |
| PD 70402 | Contemporary Issues in Finance | 4-0-0 |
| PD 70403 | Contemporary Issues in Marketing Management | 4-0-0 |
| PD 70404 | Contemporary Issues in Human Resource Management | 4-0-0 |

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| Course Code: PD 70401 | Title: Management Philosophy and Practices | L T P C 4 0 0 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | This course is designed to familiarize the research scholars with the philosophical foundations and contemporary practices of management. The course provides an in-depth understanding of the evolution of management thought, major management theories, and emerging perspectives in management. It aims to develop critical thinking and analytical skills for understanding managerial issues in diverse organizational contexts. The course also focuses on innovation, knowledge management, ethics, corporate social responsibility, and global management practices to equip students with a comprehensive perspective on modern management. | |
| Expected Outcome | <ol style="list-style-type: none"> 2. To develop an advanced understanding of the evolution of management thought and major management theories. 3. To analyze the influence of culture, ethics, values, and corporate social responsibility on managerial practices. 4. To examine contemporary management approaches, innovation, change management, and knowledge management in organizations. 5. To evaluate strategic management frameworks and the contributions of leading management thinkers to organizational effectiveness and competitiveness. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Evolution of Management Thought and Classical Theories | 8 |
| Early Writing in Management, Classical theories: Scientific Management, Administrative management, Bureaucratic Management, etc - Classical Theories: Behavioural Approach, Management Science Approach, System theory and Contingency Approach. | | |



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| Unit II | National Culture and Comparative Management Practices | 8 |
| National Cultures and Management Practices – Comparative Analysis of Chinese, American, Japanese and Indian Management. | | |
| Unit III | Business Environment, Ethics and Corporate Social Responsibility | 8 |
| Management of Business Environment, Corporate Social Responsibility, Ethics and Values System in Indian Business. | | |
| Unit IV | Innovation, Change and Knowledge Management | 10 |
| MBO and TQM, Creativity and Innovation in Management, Change Management, Organizational Transformation, Technology Management, Knowledge management and Learning Organizations. | | |
| Unit V | Contemporary Management Perspectives and Strategic Frameworks | 8 |
| Contemporary Management Viewpoints, Macknisey 7s Framework , 21st Century Approaches to Management - Theory Z Approach. Micheal Potter's Industry and Competitive Analysis. Contribution of C K Prahalad, Hamel, Peter Ducker, Henry Mintzberg and Harward Simen. | | |
| Text Books | 4. Dr. R N Singh, " Management Thought and Thinkers", Sultan Chand & Sons, New-Delhi. 5. 2. Dr. Prabhudutta Sharma, " management Thought & Thinkers", Vishwabharti. Publication, NewDelhi | |
| Reference Books | 3. Edward De Bono, "Lateral Thinking for Management", McGraw-hill, Book Company, UK | |
| Mode of Evaluation | | |
| Date of approval by the Academic Council | | |

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| Course Code : PD 70402 | Title: Contemporary Issues in Finance | L T P C 4 0 0 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | This course is to familiarize the students with the advanced knowledge in the discipline of financial management. The course has been designed to provide the research students with knowledge of emerging issues and trends in financial markets and new innovations in the financial sector. The emphasis in the course will be on the practical knowledge along with the conceptual understanding of the subject. The course also aims at providing an international perspective in the field to the students. | |
| Expected Outcome | <ul style="list-style-type: none"> To develop advanced understanding of financial management concepts and policies. To analyze stock market operations and financial regulations in India. To study corporate restructuring, mergers, acquisitions, and financial innovations. To understand international finance, banking systems, and risk management practices. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Financial Management and Policy | 8 |
| Concept, objectives and components of Strategic planning process. Linkage between corporate strategy and financial strategy. Implications of capital budgeting, capital structure and dividend policy on corporate | | |



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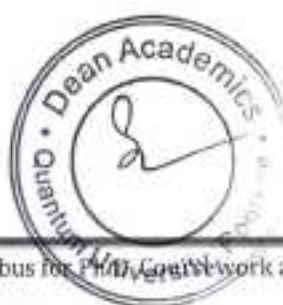
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| strategy: Shareholders value creation. Security Valuation Principals and Models: Bonds, Equities, Preference shares. | | |
| Unit II | Stock Market and Regulation in India | 8 |
| Stock Exchanges in India: Listing of Scrips, On-Line Trading, Depositories, Trading, Settlement, Risk Management, Investor Grievances, Basics of Pricing Mechanism, Inside trading, Circular trading, Price rigging, Regulation of Indian Capital Market: SEBI, Stock Exchange Board. Stock Indices, Role of FIIS, MFs, and Investment Bankers in the Stock market. | | |
| Unit III | Corporate Restructuring | 10 |
| Need, Methods of restructuring, Mergers and Acquisitions, Divestiture, contracting out, Outright sale, Disinvestment, leveraged buyout. Mergers and Acquisitions: Motives, considerations in M&A decisions, Synergy Value. Due Diligence Process, Business Valuation Methods, Evaluation of Mergers and Acquisitions and regulations. Behavioral Finance, Conceptual and Research Issues, Micro Financing in India, Financial inclusion and role of Banks. | | |
| Unit IV | International Financial Management | 8 |
| Its organization, Opportunities and challenges of Multinational Corporations; Foreign Exchange Markets: Spot market, Forward market. Mechanism of foreign exchange management, Derivatives: forwards, futures, options, swaps. | | |
| Unit V | Banking System in India | 8 |
| Organisation, Structure, Emerging scenario of Banking in India. Entry of Private and foreign Banks. Financial Innovation and Opportunities for Banks: Universal Banking, Banc assurance, Factoring and Securitization. Regulation of Banking Sector; Role of RBI: Prudential Norms and performance measurement, CRR, SLR, CRAR, NPA, Income recognition, Asset qualification and Provisioning norms, Basel accord. Risk Management in Banks, Asset liability Management Using traditional GAP and modern techniques. | | |
| Text Books | 6. J. Fred. Weston, Mark L. michell, J. Harold Mulherin, " Take Overs, Restructuring & Corporate Governance" Pearson Education Inc. 7. M. Y. Khan " Indian Financial System" Tata McGraw-HILL Publishing Company Ltd., New Delhi. | |
| Reference Books | 4. James C Van harné, " Financial Management & Policy" Pearson | |
| Mode of Evaluation | | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

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| Course Code: PD 70403 | Title: Contemporary Issues in Marketing Management | L T P C 4 0 0 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | The course aims to develop understanding of the Modern day marketing functions in the corporate enterprises and various research and policy implications. To develop knowledge and understanding of Ph.D. students on the various aspects of modern marketing management. To enable students to identify research issues in the specialization area. To develop insight of students as to the area and topic in the area that they may work up to develop their Ph.D. proposals. | |
| Expected Outcome | <ul style="list-style-type: none"> To develop understanding of modern marketing concepts and market analysis. To examine service marketing, retail marketing, and customer evaluation techniques. To understand marketing research tools and statistical applications in marketing studies. To identify emerging issues and research opportunities in marketing management. | |



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| Unit No. | Unit Title | No. of hours (per Unit) |
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| Unit I | Modern Marketing and Analyzing Market Opportunities | 8 |
| Marketing Tasks and Approaches to Modern Marketing, Marketing Environment and Environment Scanning, Analyzing Market Environment. Role of Marketing in Corporate sector in Recent era: 4Ps & beyond, Marketing Challenges, Marketing information system and Marketing Research, Strategic Planning in Marketing Management. | | |
| Unit II | Service Marketing and Customer Evaluation | 8 |
| Service Marketing : Concepts, Characteristics and Classification. Marketing Mix for Services. Problems in marketing of Services. Marketing Strategies for Service Firms. A brief study of Specific Services.: Tourism, Hospitality, Banking and Insurance Services. Customer Evaluation of Service Quality: Gaps Model for improving the Quality of Service - knowledge gap, standards gap, delivery gap, communications gap. Service Recovery. | | |
| Unit III | Marketing Research | 10 |
| Measurement Process in Marketing Research: Measurement in Marketing, Difficulties in Measurement, Concepts of Validity and Reliability; Attitude Measurement: Importance of Attitude in Marketing, Nature of Attitudes and their Measurement, Attitude Scaling Procedures, Thurston Scale, Likert Scale, Paired Comparison Scale. Semantic Differential Scale and Multi-Dimensional Scale (MDS) and Their Applications. Applied Marketing Research: Demand Measurement and Forecasting, Product Research, Advertising Research, Distribution Research, Sales Control Research, Pricing Research, Motivation Research. Use of Statistical Package for Social Sciences (SPSS) in Marketing Research. | | |
| Unit IV | Retail Marketing | 8 |
| Retail Marketing: Retailing in India, Significance of retail industry, Marketing retail equations, new role of retailers, Indian retail scenario and its future prospects, Retail Formats and Theories, Theories of retail development, Concept of retail life cycle, Classification of retail stores, the role of franchising in retail. FDI in retail. Understanding the Retail Consumers: The factors influencing retail shopper, Consumer decision making process, changes in the Indian consumer, the use of market research as a tool for understanding markets and consumers, Store Locations. | | |
| Unit V | Emerging Issues in Marketing Management | 8 |
| Emerging Issues in Marketing: Green Marketing, Holistic Marketing, Network Marketing, Event Marketing, Nucleus Marketing; Mergers and Acquisitions: Regulatory Framework, Marketing Issues and Relevance in 21st century business Enterprises Competing through E-Marketing – Components of e-marketing, Impact of e-Marketing on marketing Strategy. | | |
| Text Books | <ol style="list-style-type: none"> 1. Kotler Philip & Armstrong, G., Principles of Marketing, Prentice-Hall of India, , 2008. 2. Kotler Philip, Marketing Management, Prentice-Hall of India, 2007 | |
| Reference Books | <ol style="list-style-type: none"> 1. Kotler Philip & Keller, Principles of Marketing, Prentice-Hall of India, 2007. 2. Saxena Rajan, Marketing Management, Tata McGraw-Hill Publishing Co. Ltd., 3rd Edition. | |
| Mode of Evaluation | | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |
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| Course Code-PD 70404 | Title: Contemporary Issues in Human Resource Management | L T P C 4 0 0 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | The student should be able to critically analyze organizational situations, prescribe courses of action necessary for problem solving, and integrating the steps necessary for effective implementation. Upon completion, the Ph.D. student should be able to indicate and explain various research issues in HR interventions that may be required when dealing with the work environment, people and problems. | |
| Expected Outcome | <ul style="list-style-type: none"> To develop critical understanding of strategic and global human resource management. To study employee acquisition, training, performance appraisal, and retention strategies. To examine organizational change, motivation, leadership, and industrial relations issues. To understand ethical, cultural, and international dimensions of human resource management. | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Introduction of HRM | 10 |
| An overview of Human Resource Management: Framework of HRM in the present day corporate sector; environmental scanning, HRM in the Global Context. Challenges of HRM. Strategic HRM. Manpower Search; Employee Acquisition Strategies and Selection Process in Corporate Sector, Career & Competence Development, Training and Retraining. Measuring Training Effectiveness. Job Involvement, Employee Engagement. Performance Appraisal and Potential Evaluation, Employee Empowerment, Compensation, Incentives and Fringe benefits. Retention Strategies: Counseling & Mentoring, Managing Separations and Rightsizing. | | |
| Unit II | Organizational Change & Development | 8 |
| Measurement and Coping strategies for frustration, Stress & Burn out. Quality of Work Life, Work Life Balance, Motivation, Leadership Styles, Job Satisfaction, Organization Culture, Organizational Effectiveness | | |
| Unit III | Industrial Relations | 8 |
| Causes of Industrial Unrest and Remedial Measures, Industrial disputes in India, Employment Security and Management of Redundancies. Trade Unionism in India. Social Security, Health & Welfare Measure in India. | | |
| Unit IV | Ethical Issues in Human Resource Management | 8 |
| Need and Implications of Ethics for Human Resource Management. Corporate Social Responsibility, Indian Ethos, Values, Human Values in HRM. HRD: HRD Practices, HRD Audit, HRD Culture & Climate; Strategic HRD | | |
| Unit V | International Human Resource Management | 8 |
| Dynamics of HRM in Multinational Corporations, Cross Cultural HRM. Human Relations Challenges of the Future | | |
| Text Books | <ol style="list-style-type: none"> Snell Scott & Bohlander George: Human Resource Management, Cengage Learning India Pvt. Ltd., New Delhi. Werener J M & Desimone RL: Human Resource Development, Cengage Learning India Pvt. Ltd., New Delhi. | |
| Reference Books | <ol style="list-style-type: none"> Garry Desseler, Human Resource Management, Prentice-Hall India Pvt. Ltd., New Delhi, 10th Edition. | |
| Mode of Evaluation | | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

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Department of Nutrition and Dietetics
(Choose any one)

| Course Code | Title | Teaching Scheme |
|-------------|--|-----------------|
| PD 70501 | Advanced Nutritional Biochemistry & Human Metabolism | 3-0-2 |
| PD 70502 | Clinical Nutrition and Metabolism | 3-0-2 |
| PD 70503 | Nutritional Epidemiology & Public Health | 3-0-2 |
| PD 70504 | Food Science & Processing Technology | 3-0-2 |

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|-----------------------|---|----------------------------|
| Course Code- PD 70501 | Title: Advanced Nutritional Biochemistry & Human Metabolism | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | To provide advanced knowledge of metabolic pathways, molecular nutrition, and biochemical mechanisms regulating human health and disease. | |
| Expected Outcome | Students will be able to analyze metabolic processes and apply biochemical principles in nutrition research and clinical practice. | |
| Unit No. | | No. of hours (per Unit) |
| Unit I | Cellular and Molecular Basis of Human Metabolism | 9 |
| | Organization of cells and subcellular compartments, Biochemical composition of human tissues, Enzymes: classification, kinetics, regulation, and coenzymes, Bioenergetics and biological oxidation, ATP generation and electron transport chain, Cell signalling pathways in nutrition, Hormonal regulation of metabolism, Molecular mechanisms regulating metabolic homeostasis | |
| Unit II | Carbohydrate and Lipid Metabolism | 9 |
| | Digestion, absorption, and transport of carbohydrates, Glycolysis, gluconeogenesis, glycogen metabolism, Pentose phosphate pathway and TCA cycle, Regulation of blood glucose homeostasis, Lipid digestion, absorption, transport, and storage, Fatty acid synthesis and β -oxidation, Ketogenesis and cholesterol metabolism, Lipoprotein metabolism and dyslipidemia, Metabolic alterations in obesity and diabetes mellitus | |
| Unit III | Protein, Amino Acid and Nucleotide Metabolism | 9 |
| | Protein digestion, absorption, and turnover, Amino acid catabolism and transamination, Urea cycle and ammonia detoxification, Biosynthesis of non-essential amino acids, Branched-chain amino acid metabolism, Nucleotide synthesis and degradation, Integration of protein metabolism during starvation and stress, Inborn errors of amino acid metabolism, Clinical significance of nitrogen balance | |
| Unit IV | Micronutrient Metabolism and Molecular Nutrition | 8 |
| | Biochemical functions of vitamins and minerals, Metabolism of fat-soluble and water-soluble vitamins, Mineral metabolism: calcium, iron, zinc, iodine, selenium, magnesium, Oxidative stress and antioxidant defense systems, Nutrigenomics and nutrigenetics, Epigenetic regulation of nutrition, Role of micronutrients in immunity and inflammation, Molecular biomarkers in nutritional assessment | |
| Unit V | Integrated Human Metabolism and Recent Advances | 10 |
| | Metabolic integration during fed and fasting states, Metabolic adaptations in exercise, pregnancy, aging, and critical illness; Gut microbiota and metabolic health, Nutritional metabolomics and systems biology, Advanced techniques in metabolic research, Biomarkers and molecular diagnostics in nutrition, Clinical applications of metabolic nutrition, Current advances in precision nutrition and personalized diets, Recent research trends in nutritional biochemistry | |
| Reference Books | <ul style="list-style-type: none"> a. Harper's Illustrated Biochemistry b. Lehninger Principles of Biochemistry c. Advanced Nutrition and Human Metabolism – Gropper & Smith d. Modern Nutrition in Health and Disease e. Textbook of Medical Biochemistry – Chatterjee & Shinde f. Annual Review of Nutrition g. American Journal of Clinical Nutrition h. Journal of Nutritional Biochemistry | |
| E-Resource | <ul style="list-style-type: none"> • NPTEL – Biochemistry and Metabolism Courses • SWAYAM Online Learning Portal • PubMed – Nutrition and Metabolism Research Articles • National Center for Biotechnology Information (NCBI) | |

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| Mode of Evaluation | Internal and External |
| Recommendation by Board of Studies on | |
| Date of approval by the Academic Council | 06/10/2023 |

Course Outcome for PD 70501

| Unit-wise Course Outcome | Descriptions | BL Level | Employability (Emp)/ Skill(S)/ Entrepreneurship (Emt)/ None (Use , for more than One) |
|--------------------------|--|----------|---|
| CO1 | Explain the cellular, molecular, and biochemical mechanisms regulating human metabolism and metabolic homeostasis. | 2 | Emp, S |
| CO2 | Analyze carbohydrate and lipid metabolic pathways and their role in metabolic disorders such as obesity and diabetes mellitus. | 4 | Emp, S |
| CO3 | Evaluate protein, amino acid, and nucleotide metabolism in physiological and pathological conditions. | 4 | Emp, S |
| CO4 | Assess the role of micronutrients, nutrigenomics, and oxidative stress in human health and disease prevention. | 3 | Emp, S |
| CO5 | Integrate advanced concepts of human metabolism, metabolomics, and precision nutrition in clinical and research applications. | 5 | Emp, S, Emt |

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| Course Code- PD 70502 | Title: Clinical Nutrition and Metabolism | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | To develop expertise in medical nutrition therapy, metabolic responses to diseases, and advanced clinical nutrition management. | |
| Expected Outcome | Students will be able to design evidence-based nutritional interventions for clinical and critical care conditions. | |
| Unit No. | | No. of hours (per Unit) |
| Unit I | Foundations of Clinical Nutrition and Metabolic Response to Disease | 8 |
| Concepts and scope of clinical nutrition, Nutritional assessment in clinical practice, Screening tools and nutritional risk assessment, Body composition and metabolic assessment, Energy balance and metabolic adaptation, Stress metabolism and inflammatory response. Hormonal and biochemical changes during illness, Nutrition care process and evidence-based nutrition practice, Ethical and clinical considerations in nutritional care | | |
| Unit II | Medical Nutrition Therapy in Non-Communicable Diseases | 8 |
| Medical nutrition therapy for obesity and metabolic syndrome, Nutritional management in diabetes mellitus, Diet therapy for cardiovascular diseases and hypertension, Nutritional care in dyslipidemia and atherosclerosis, Nutrition intervention in cancer and cachexia, Role of functional foods and nutraceuticals in NCD management, Glycemic index, dietary fats, and fiber in disease prevention, Lifestyle modification and behavior change strategies, Recent guidelines and evidence in NCD nutrition therapy | | |
| Unit III | Renal, Hepatic and Gastrointestinal Nutrition | 8 |

Lab work as approved by Academic Council 06/10/2023



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| Nutritional management in acute and chronic kidney disease, Diet planning in dialysis and nephrotic syndrome, Nutrition therapy in liver disorders: hepatitis, cirrhosis, fatty liver disease, Enteral and parenteral nutrition in gastrointestinal disorders, Nutrition in malabsorption syndromes and inflammatory bowel disease, Pancreatic disorders and nutrition support, Fluid, electrolyte, and acid-base balance, Role of probiotics, prebiotics, and synbiotics in gut health, Nutritional complications and metabolic alterations in organ dysfunction | | |
| Unit IV | Critical Care Nutrition and Advanced Nutrition Support | 10 |
| Metabolic response in trauma, burns, sepsis, and surgery, Nutritional support in intensive care units, Enteral nutrition: indications, formulations, and monitoring, Parenteral nutrition: composition, administration, and complications, Nutrition in respiratory disorders and mechanically ventilated patients, Immunonutrition and pharmaconutrition, Refeeding syndrome and metabolic complications, Pediatric and geriatric critical care nutrition, Monitoring and evaluation of nutrition support therapy | | |
| Unit V | Emerging Trends and Research in Clinical Nutrition and Metabolism | 8 |
| Precision nutrition and personalized dietary therapy, Nutrigenomics and metabolomics in clinical nutrition, Gut microbiome and metabolic health, Artificial intelligence and digital tools in nutrition care, Biomarkers in clinical nutrition research, Clinical trials and evidence-based nutrition practice, Nutrition policies and clinical guidelines, Ethical issues in clinical nutrition research, Recent advances and future perspectives in metabolic nutrition | | |
| Reference Books | <ul style="list-style-type: none"> ☐ Krause's Food & the Nutrition Care Process ☐ Modern Nutrition in Health and Disease ☐ Clinical Nutrition – Whitney & Rolfes ☐ ASPEN Clinical Guidelines ☐ ESPEN Guidelines on Clinical Nutrition ☐ Advanced Nutrition and Human Metabolism – Gropper & Smith ☐ Journal of Clinical Nutrition ☐ American Journal of Clinical Nutrition ☐ Nutrition in Clinical Practice Journal | |
| E-Resource | <ul style="list-style-type: none"> • ASPEN Clinical Guidelines • ESPEN Guidelines on Clinical Nutrition • SWAYAM Online Courses in Clinical Nutrition • PubMed – Clinical Nutrition Research Database | |
| Mode of Evaluation | Internal and External | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

Course Outcome for PD 70502

| Unit-wise Course Outcome | Descriptions | BL Level | Employability (Emp)/ Skill(S)/ Entrepreneurship (Emt)/ None (Use , for more than One) |
|--------------------------|---|----------|---|
| CO1 | Explain principles of clinical nutrition, nutritional assessment, and metabolic responses during disease conditions. | 2 | Emp, S |
| CO2 | Apply medical nutrition therapy strategies for prevention and management of non-communicable diseases. | 3 | Emp, S |
| CO3 | Analyze nutritional management approaches for renal, hepatic, and gastrointestinal disorders. | 4 | Emp, S |
| CO4 | Evaluate critical care nutrition support methods including enteral and parenteral nutrition therapy. | 4 | Emp, S |
| CO5 | Assess emerging trends, precision nutrition approaches, and research applications in clinical nutrition and metabolism. | 5 | Emp, S, Emt |

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| Course Code- PD 70503 | Title : Nutritional Epidemiology & Public Health | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | To understand epidemiological approaches in nutrition, community nutritional assessment, and public health intervention strategies. | |
| Expected Outcome | Students will be able to assess community nutritional problems and develop effective public health nutrition programs. | |
| Unit No. | | No. of hours (per Unit) |
| Unit I | Foundations of Nutritional Epidemiology and Public Health Nutrition | 8 |
| Concepts, scope, and significance of nutritional epidemiology, Principles of public health nutrition, Epidemiological methods in nutrition research, Measures of disease frequency and association, Study designs: cross-sectional, cohort, case-control, and intervention studies, Nutritional transition and global burden of malnutrition, Social determinants of health and nutrition, Nutrition surveillance systems and public health databases, Ethical considerations in epidemiological research | | |
| Unit II | Assessment of Nutritional Status and Dietary Intake | 8 |
| Methods of dietary assessment: 24-hour recall, food frequency questionnaire, diet history, Anthropometric assessment techniques, Biochemical and clinical assessment of nutritional status, Functional assessment methods, Nutritional indicators and growth standards, Assessment of food security and dietary diversity, Community nutritional assessment techniques, Nutritional surveillance and monitoring systems, Interpretation of nutritional data and risk analysis | | |
| Unit III | Nutritional Disorders and Community Health Problems | 10 |
| Protein-energy malnutrition and micronutrient deficiencies, Public health significance of anemia, vitamin A deficiency, iodine deficiency disorders, Nutritional epidemiology of obesity and non-communicable diseases, Double burden of malnutrition, Maternal and child nutrition issues, School health and adolescent nutrition, Geriatric nutrition and aging population, Nutrition and infectious diseases, Socioeconomic and environmental factors affecting nutritional health | | |
| Unit IV | Nutrition Intervention Programs and Public Health Policies | 8 |
| Planning and implementation of nutrition intervention programs, National and international nutrition programs and policies, School feeding and supplementary nutrition programs, Food fortification and biofortification strategies, Behavior change communication in nutrition, Community participation and nutrition education, Monitoring and evaluation of nutrition programs, Sustainable Development Goals (SDGs) and nutrition, Role of government and international agencies in nutrition programs | | |
| Unit V | Advanced Research Methods and Emerging Trends in Public Health Nutrition | 8 |
| Statistical applications in nutritional epidemiology, Data management and interpretation in nutrition research, Systematic reviews and meta-analysis, Geographic information systems (GIS) in public health nutrition, Nutritional genomics and population health, Digital health technologies and nutrition surveillance, Precision public health nutrition, Research ethics and scientific writing, Recent advances and future trends in nutritional epidemiology | | |
| Reference Books | <ul style="list-style-type: none"> Nutritional Epidemiology - Walter Willett Public Health Nutrition - Sari Edelstein Modern Nutrition in Health and Disease Community Nutrition in Action Essentials of Public Health Nutrition WHO Guidelines on Nutrition and Public Health American Journal of Public Health Journal of Nutrition and Public Health The Lancet Public Health • National Family Health Survey | |
| E-Resource | <ul style="list-style-type: none"> • World Health Organization (WHO) Nutrition Resources • UNICEF Nutrition and Public Health Resources • National Family Health Survey (NFHS) • SWAYAM Public Health and Epidemiology Courses | |
| Mode of Evaluation | Internal and External | |
| Recommendation by Board of Studies on | | |



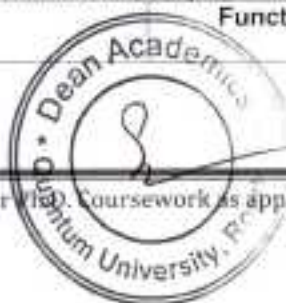
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Date of approval by the Academic Council 06/10/2023

Course Outcome for PD 70503

| Unit-wise Course Outcome | Descriptions | BL Level | Employability (Emp)/ Skill(S)/ Entrepreneurship (Emt)/ None (Use , for more than One) |
|--------------------------|--|----------|---|
| CO1 | Explain concepts, methods, and applications of nutritional epidemiology and public health nutrition. | 2 | Emp, S |
| CO2 | Apply dietary, anthropometric, biochemical, and community-based assessment methods to evaluate nutritional status. | 3 | Emp, S |
| CO3 | Analyze the epidemiology and public health impact of nutritional disorders and community health problems. | 4 | Emp, S |
| CO4 | Design and evaluate nutrition intervention programs, policies, and behavior change communication strategies. | 5 | Emp, S, Emt |
| CO5 | Assess advanced research methodologies, digital technologies, and emerging trends in public health nutrition research. | 5 | Emp, S |

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| Course Code- PD 70504 | Title : Food Science & Processing Technology | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objectives | To provide advanced understanding of food composition, processing technologies, food safety, and functional food development. | |
| Expected Outcome | Students will be able to apply food science and processing principles for quality improvement, disease prevention, and innovative food product development. | |
| Unit No. | | No. of hours (per Unit) |
| Unit I | Fundamentals of Food Science and Food Composition | 8 |
| Scope and importance of food science and processing technology, Physical, chemical, and biological properties of foods, Composition and structure of carbohydrates, proteins, lipids, vitamins, minerals, and water, Functional properties of food components, Food chemistry and biochemical changes during processing, Food additives, preservatives, and nutraceutical ingredients, Rheology and sensory properties of food, Nutritional significance of food components, Food standards and regulations | | |
| Unit II | Food Microbiology and Food Safety | 8 |
| Principles of food microbiology, Beneficial and spoilage microorganisms in foods, Foodborne pathogens and foodborne diseases, Microbial growth and factors affecting microbial survival, Food contamination and spoilage mechanisms, Food hygiene and sanitation practices, Hazard Analysis and Critical Control Point (HACCP), Food safety management systems and quality assurance, Detection methods for microbial and chemical contaminants | | |
| Unit III | Advanced Food Processing and Preservation Technologies | 8 |
| Conventional and modern food processing techniques, Thermal processing: pasteurization, sterilization, blanching, Non-thermal processing technologies: high-pressure processing, irradiation, pulsed electric field, Drying, freezing, and dehydration technologies, Fermentation technology and probiotic foods, Packaging technologies and shelf-life enhancement, Food engineering principles in processing operations, Process optimization and product stability, Impact of processing on nutritional quality | | |
| Unit IV | Functional Foods, Nutraceuticals and Therapeutic Applications | 8 |



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Concepts and classification of functional foods and nutraceuticals, Bioactive compounds in foods , Functional ingredients: probiotics, prebiotics, synbiotics, polyphenols, omega-3 fatty acids, Development of therapeutic and fortified foods, Food products for lifestyle disorders and clinical conditions, Role of functional foods in disease prevention and health promotion, Personalized nutrition and specialized dietary products, Regulatory and ethical considerations in functional food development, Consumer acceptance and sensory evaluation

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| Unit V | Research Innovations and Emerging Trends in Food Science | 10 |
| Advanced analytical techniques in food research, Food metabolomics and molecular food science , Nanotechnology and biotechnology in food processing, Artificial intelligence and automation in food industries, Sustainable food systems and green processing technologies, Food waste management and circular economy approaches, Clinical and public health applications of food science, Research methodology and scientific writing in food science, Recent advances and future trends in food processing technology | | |
| Reference Books | Food Science-Norman N. Potter <input type="checkbox"/> Food Chemistry-Owen R. Fennema Principles of Food Processing -Eshta A. <input type="checkbox"/> Food Microbiology -Frazier & Westhoff <input type="checkbox"/> Introduction to Food Engineering □ Singh & Heldman <input type="checkbox"/> Functional Foods and Nutraceuticals □ Wildman <input type="checkbox"/> Journal of Food Science <input type="checkbox"/> Trends in Food Science & Technology • Food Research International | |
| E-Resource | <ul style="list-style-type: none"> • NPTEL – Food Processing and Preservation Technology • Food and Agriculture Organization (FAO) Food Safety Resources • Institute of Food Technologists (IFT) • SWAYAM Food Technology Courses | |
| Mode of Evaluation | Internal and External | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

Course Outcome for PD 70504

| Unit-wise Course Outcome | Descriptions | BL Level | Employability (Emp)/ Skill(S)/ Entrepreneurship (Emt)/ None (Use , for more than One) |
|--------------------------|---|----------|---|
| CO1 | Explain the composition, functional properties, and biochemical characteristics of foods and food components. | 2 | Emp, S |
| CO2 | Analyze microbiological principles, food safety hazards, and quality assurance systems in food processing. | 4 | Emp, S |
| CO3 | Evaluate conventional and advanced food processing and preservation technologies for improving food quality and shelf life. | 4 | Emp, S |
| CO4 | Assess the development and therapeutic applications of functional foods, nutraceuticals, and specialized dietary products. | 5 | Emp, S, Emt |
| CO5 | Apply advanced analytical techniques and emerging innovations in food science research and sustainable food systems. | 5 | Emp, S, Emt |



N. Singh

Department of Civil Engineering
(Choose any one)

| Course Code | Title | Teaching Scheme |
|-------------|--|-----------------|
| PD 70701 | Computational Methods and Emerging Technologies in Civil Engineering | 3-0-2 |
| PD 70702 | Advanced Concrete Technology | 3-0-2 |
| PD 70703 | Project Planning and Control | 3-0-2 |

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|---|--|-------------------------------|
| Course Code- PD 70701 | Title: Computational Methods and Emerging Technologies in Civil Engineering | L T P C 3 0 2 4 |
| Version No. | 1.0 | |
| Course Prerequisites | Nil | |
| Course Objective | To develop advanced knowledge and practical understanding of emerging computational, analytical, digital, and sustainable technologies in Civil Engineering, enabling students to apply interdisciplinary approaches and modern engineering tools for solving complex infrastructure and research problems. | |
| Course Outcome | <ul style="list-style-type: none"> • CO1: Apply advanced computational tools and AI techniques in Civil Engineering. • CO2: Analyze engineering problems using numerical and analytical methods. • CO3: Evaluate smart and sustainable infrastructure systems. • CO4: Utilize IoT, BIM, and automation technologies in construction and infrastructure management. • CO5: Integrate interdisciplinary technologies to solve complex Civil Engineering challenges. | |
| Unit No. | Unit Title | No. of hours(per Unit) |
| Unit I | Advanced Computational Techniques in Civil Engineering | 8 |
| Artificial Intelligence and Machine Learning applications in Civil Engineering; GIS and Remote Sensing techniques for infrastructure planning and management; data visualization and interpretation; use of modern software tools for structural, transportation, geotechnical, and environmental engineering research. | | |
| Unit II | Advanced Analytical Techniques in Civil Engineering | 8 |
| Numerical methods in Civil Engineering research; optimization techniques and their engineering applications; introduction to Finite Element Method (FEM); computational modeling and simulation techniques | | |
| Unit III | Smart and Sustainable Infrastructure Development | 8 |
| Concepts of smart cities and sustainable infrastructure development; green buildings and energy-efficient construction practices; advanced and sustainable construction materials; climate-resilient infrastructure systems; modern techniques in transportation engineering and water resource engineering; recent innovations and future trends in Civil Engineering research and practice. | | |

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| Unit IV | Digital Technologies and Automation in Civil Engineering | 8 |
| Applications of Internet of Things (IoT) in Civil Engineering; Building Information Modelling (BIM) and digital construction technologies; automation and robotics in construction; integration of artificial intelligence and smart monitoring systems in infrastructure; digital transformation and emerging technological practices in Civil Engineering. | | |
| Unit V | Interdisciplinary Applications and Case Studies | 10 |
| Interdisciplinary applications of Civil Engineering in transportation, environmental, structural, geotechnical, and water resource engineering; smart mobility and intelligent transportation systems; environmental sustainability and waste management practices; structural health monitoring and rehabilitation techniques; disaster management and resilient infrastructure systems; modern technologies in water resource planning and management; integration of AI, IoT, GIS, and remote sensing in Civil Engineering applications; analysis of recent case studies and research publications related to emerging engineering challenges and innovative solutions | | |
| Text Books | 1. Research Methodology: Methods and Techniques – C. R. Kothari and Gaurav Garg, New Age International Publishers. 2. Design and Analysis of Experiments – Douglas C. Montgomery, John Wiley & Sons. 3. Concrete Technology – M. S. Shetty, S. Chand Publishing | |
| Reference Books | 1. Finite Element Procedures – Klaus-Jürgen Bathe, Prentice Hall. 2. Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations – Willem Kyrmell, McGraw-Hill Education. 3. GIS Fundamentals: A First Text on Geographic Information Systems – Paul Bolstad, XanEdu Publishing Inc. 4. Introduction to Environmental Engineering and Science – Gilbert M. Masters and Wendell P. Ela, Pearson Education. 5. Structural Health Monitoring: A Machine Learning Perspective – Charles R. Farrar and Keith Worden, Wiley Publications. | |
| Mode of Evaluation | Internal and External Examinations | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

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| Course Code - PD 70702 | Title: Advanced Concrete Technology | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |




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| Objective | To provide advanced knowledge and research-oriented understanding of modern concrete materials, high-performance concretes, durability aspects, advanced testing techniques and sustainable innovations in concrete technology for infrastructure applications. | |
| Outcome | <p>CO1: Analyze the hydration behavior, microstructure and properties of advanced cementitious materials and admixtures used in modern concrete technology.</p> <p>CO2: Evaluate the performance, design considerations and applications of high-performance and special concretes for advanced infrastructure systems.</p> <p>CO3: Assess the durability characteristics, deterioration mechanisms and service life performance of concrete structures under different environmental conditions.</p> <p>CO4: Apply advanced testing methods, analytical techniques and computational models for characterization and structural performance evaluation of concrete.</p> <p>CO5: Investigate sustainable materials, emerging technologies and innovative research trends in concrete technology for sustainable construction practices.</p> | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Advanced Cementitious Materials and Microstructure | 8 |
| Study of hydration mechanism of cement compounds, development of concrete microstructure, characterization techniques, supplementary cementitious materials, nano-materials in concrete, chemical and mineral admixtures, rheological behavior of fresh concrete, and sustainable and high-performance binder systems. | | |
| Unit II | High Performance and Special Concretes | 8 |
| Concepts, properties, mix design, behavior and applications of high strength concrete, high performance concrete, self-compacting concrete, fiber reinforced concrete, ultra-high performance concrete, geopolymers concrete, reactive powder concrete, lightweight concrete and other special concrete used in modern infrastructure. | | |
| Unit III | Durability and Service Life of Concrete | 8 |
| Fundamentals of durability, mechanisms of concrete deterioration, carbonation, chloride ingress, sulphate attack, alkali-aggregate reaction, corrosion of reinforcement, permeability and transport properties, durability-based design approaches, service life prediction models and maintenance strategies for concrete structures. | | |
| Unit IV | Advanced Testing, Modeling and Structural Performance | 8 |



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| Advanced destructive and non-destructive testing techniques for concrete, microstructural and thermal analysis, fracture mechanics, creep, shrinkage and fatigue behavior, constitutive modeling of concrete, finite element applications in concrete structures, structural health monitoring and smart concrete systems. | | |
| Unit V | Sustainable and Emerging Trends in Concrete Technology | 10 |
| Green concrete technologies, low-carbon construction materials, utilization of industrial and agricultural waste in concrete, recycled aggregate concrete, self-healing concrete, 3D printed concrete, smart materials, artificial intelligence and machine learning applications in concrete technology, life cycle assessment and recent research trends in sustainable concrete construction. | | |
| Text Books | <ol style="list-style-type: none"> 1. Properties of Concrete – A. M. Neville, Pearson Education 2. Concrete Technology – M. S. Shetty, S. Chand Publications. 3. Advanced Concrete Technology – John Newman and Ban Seng Choo, Butterworth-Heinemann Publications. | |
| Reference Books | <ol style="list-style-type: none"> 1. Concrete Microstructure, Properties and Materials – P. Kumar Mehta and Paulo J. M. Monteiro, McGraw-Hill Education. 2. Design of Concrete Mixes – N. Krishna Raju, CBS Publishers. 3. Durability of Concrete – J. P. Ollivier and A. Vichot, Wiley-ISTE Publications. 4. High Performance Concrete – Pierre-Claude Aitcin, CRC Press. 5. Fiber Reinforced Cement Composites – A. Bentur and S. Mindess, CRC Press. 6. Lea's Chemistry of Cement and Concrete – Peter C. Hewlett, Elsevier Publications. | |
| Mode of Evaluation | Internal and External Examinations | |
| Recommendation by Board of Studies on | | |
| Date of approval by the Academic Council | 06/10/2023 | |

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| Course Code- PD 70703 | Title: Project Planning and Control | L T P C 3 0 2 4 |
| Version No. | 2.0 | |
| Course Prerequisites | Nil | |
| Objective | To provide advanced knowledge and research-oriented understanding of project planning, scheduling, resource optimization, monitoring, cost control and modern project management tools for efficient execution of construction and infrastructure projects. | |



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| Outcome | <p>CO1: Understand the fundamental concepts of project management, project planning processes and organizational structures used in construction projects.</p> <p>CO2: Apply project scheduling techniques such as CPM, PERT and network analysis for effective planning and execution of projects.</p> <p>CO3: Analyze resource allocation, budgeting and cost control methods for efficient project management and optimization.</p> <p>CO4: Evaluate project monitoring systems, risk management strategies, quality assurance and safety practices in construction projects.</p> <p>CO5: Investigate modern tools, digital technologies and emerging trends such as BIM, lean construction and AI applications in project planning and control.</p> | |
| Unit No. | Unit Title | No. of hours (per Unit) |
| Unit I | Fundamentals of Project Management and Planning | 8 |
| <p>Concepts of project management, project life cycle, project organization structures, project objectives and constraints, feasibility analysis, work breakdown structure, project identification and formulation, project planning process, resource planning and project documentation techniques.</p> | | |
| Unit II | Project Scheduling Techniques | 8 |
| <p>Project scheduling methods including bar charts, milestone charts, network techniques; Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), precedence networks, time estimation, project sequencing, float analysis and project scheduling using software tools.</p> | | |
| Unit III | Resource Management and Cost Control | 8 |
| <p>Resource allocation and leveling, optimization techniques, manpower planning, equipment management, project budgeting, cost estimation methods, earned value analysis, cash flow analysis; project financing, cost monitoring and project cost control techniques.</p> | | |
| Unit IV | Monitoring, Risk and Quality Control | 8 |
| <p>Project monitoring and tracking systems, performance measurement, progress reporting, project audits, quality management in construction projects, risk identification and assessment, risk mitigation techniques, safety management and dispute resolution in project execution.</p> | | |
| Unit V | Advanced Tools and Emerging Trends in Project Management | 10 |
| <p>Application of BIM in project management, lean construction principles, digital project management tools, artificial intelligence and data analytics in project control, sustainability in project management, contract administration, smart construction practices and recent advancements in project planning and control.</p> | | |



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| Text Books | 1. Construction Planning and Management – P. S. Gahlot and B. M. Dhir, New Age International Publishers. 2. Project Planning and Control with PERT and CPM – B. C. Punmia and K. K. Khandelwal, Laxmi Publications. |
| Reference Books | 1. Construction Project Management – K. K. Chitkara, Tata McGraw-Hill Publications. 2. Project Management: A Systems Approach to Planning, Scheduling, and Controlling – Harold Kerzner, Wiley Publications. 3. Construction Management and Planning – Sengupta and Guha, Tata McGraw-Hill Publications. |
| Mode of Evaluation | Internal and External Examinations |
| Recommendation by Board of Studies on | |
| Date of approval by the Academic Council | 06/10/2023 |



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