SHRI GURU RAM RAI UNIVERSITY

PATEL NAGAR, DEHRADUN-248001, UTTARAKHAND, INDIA
(Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no.03 of 2017)

SCHEME AND SYLLABUS FOR PRE-Ph.D. COURSE MATHEMATICS

(CHOICE BASED CREDIT SYSTEM)
DEPARTMENT OF MATHEMATICS
SCHOOL OF BASIC AND APPLIED SCIENCES

(w. e. f. 2021- 2022)

Programme Outcome:

PO1.	Develop deeper understanding of a subject for its application in addressing social and scientific issues.
PO2.	To understand the critical aspects of conducting ethical research for sustainable development.
PO3.	To develop the reasoning-based solution to the scientific problem.
PO4.	To understand the impact of research & development on environment safety and sustenance.
PO5.	Inculcate the leadership skills required to identify the problem and finding the solution in coherence with the teamwork.
PO6.	To develop the skill set of designing and executing experiments pertaining to a targeted scientific problem.
PO7.	Develop the analytical skills prerequisite for analysing the research findings and correlating with the set objectives.
PO8.	To develop meticulous scientific writing skills for presenting the research outcomes.

Program Specific Outcome (PSOs):

On completion of the programme, students will be able to

PSO1.	To investigate emerging areas of research in mathematical sciences and study the research problems in the context of latest issues in the field.
PSO2.	To review research literature, identify, formulate and solve mathematical models for the real life problems.
PSO3.	To identify and evaluate appropriate research sources and Apply knowledge of research methodology and its various tools techniques for arriving at substantiated conclusions of the research problems.
PSO4.	To Carry out computation and data analyses using computer software packages. Attain in-depth knowledge in the field of specialization and ability to conduct research which results in strengthening the discipline and its teaching.

Eligibility for admission:

Any candidate who has passed the PG degree in Mathematics from any state recognized or equivalent University with not less than 55 % marks in aggregate is eligible for admission. Along with this candidate has to clear RET conducted by SGRR University. However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules. If candidate already has been cleared CSIR NET (with or without JRF) in Mathematics, he/she has been exempted for RET according to university norms.

Duration of the Programme: 3 Years
Study & Evaluation Scheme
(Choice Based Credit System/ECS)
PRE- Ph.D. COURSE IN MATHEMATICS

Course Type: Core Course (C), Subject specific Elective Course (E)

First Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total	Minimum marks to be scored for successful completion
				L	T	P	C	Sessional (Internal)	External (ESE)		
Theory											
1	Core	PRMC101	Research Methodology	2	1	1	4	20	60	80	40
2.	Core	PREC 102	Research and Publication Ethics (RPE)	1	1	0	2	10	30	40	20
3.	Subject specific core	PMTC 103	Tools & Techniques	2	1	1	4	20	60	80	40
4.	Subject specific elective	PMTE 104	Advanced Numerical Method	2	1	1	4	20	60	80	40
5.	Subject specific elective	PMTE 105	Mathematical Modelling	2	1	1	4	20	60	80	40
6.	Subject specific elective	PMTE 106	Differential Geometry	2	1	1	4	20	60	80	40
	Subject specific elective	PMTE 107	Fuzzy logic and its applications	2	1	1	4	20	60	80	40
Practical											
7.	Core	PMTF 108	**Field work***	0	2	2	4	80		80	40
			Total	7	6	5	18	150	210	360	180

Note 1: * Field work includes the Seminar / Conference Presentation / Review literature, Journal club and other activities assigned.

Note 2: Each candidate is required to take one elective course of subject specific.

Examination Scheme:

Components	Internal Exam	External Exam (ESE)
Weightage (%)	20	60

COURSE NAME: RESEARCH METHODOLOGY

Course code : PRMC 101:				
Course Name : Research Methodology				
Semester /Year : 2021-2022				
Core Paper	L	T	P	C
Paper I:	2	1	1	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

- To gain familiarity with a phenomenon or to achieve new insights into it.
- To familiarize the students with general techniques of performing analysis of data and modelling using various simulation techniques.
- This course will enable students to design experiments and methods to extract data.
- To find solution to theoretical and practical problems.

Unit 1- Concept & Types of Research

Meaning and importance of Research – Types of Research – Selection and formulation of Research Problem –Research Design, Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation research/Studies, Action Research, Experimental Research, Analytical Study of Statistical Method, Historical Research. History and basic concepts (validity, reliability, objectivity and subjectivity) characteristics and format. Steps to better writing, flow method, organization of material and style.

Unit 2 - Methods Research

Surveys, Case Study, Field Studies General Survey of various Methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Statistical Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self- Correcting, Deterministic, Ethical & Ideological neutrality (Value Free), Statistical Generalizability.

Unit 3 - Data Collection and Data Analysis

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data. Primary, Secondary and Tertiary Data. Construction and adaptation of instruments, administration of questions and tests. Data organization in SPSS & Excel, Graphical representation of data. Definition and Aims of Content Analysis, Problems of Content Analysis, Computer and Content Analysis Discussion and Interpretation of results, Testing of Hypothesis: Logical and Statistical Techniques.

Unit 4 - Report Writing:

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

Suggested Readings:

1. Bagchi, Kanak Kanti., Research Methodology in Social Sciences: A Practical Guide, Abijeet Publications. Delhi 2007.
2. Kothari, C. R. and Garg, G., Research Methodology: Methods and Techniques, 3rd edition, New Age International Publishers, New Delhi, 2014.
3. Montgomery, D.C., Design and Analysis of Experiments, 8th edition, Wiley India, 2013.
4. Cooper, R. Donald and Pamela S. Schindler, Business Research Methods, Tata McGraw-Hill, Delhi, 2003.

5. Pannerselvan, R., Research Methodology, Prentice Hall of India, New Delhi, 2009.
6. Singh, Y.K., Fundamental of Research Methodology and Statistics, New Age International Publishers, New Delhi, 2008.
7. Flyvbjerg, B., Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press, 2001.
8. Goodde and Hatte. Methods in Social Research, McGraw – Hill, New York, 1952.
9. Prathapan, K., Research Methodology for Scientific Research, IK International, New Delhi, 2014.

Course outcomes (COs):

After successfully completion of the course, student will be able to

CO1	To develop understanding of the basic framework of research process. To identify various sources of information for literature review and data collection
CO2	To develop an understanding of various research designs and techniques
CO3	To develop and understand the different techniques of research modelling, data collection, designing and planning of experiments, basic of Data organization in SPSS & Excel, Graphical representation of data etc.
CO4	To enable to analyze data and write report based on data analyzed and Appreciate the components of scholarly writing and evaluate its quality.

COURSE NAME: RESEARCH AND PUBLICATION ETHICS (RPE)

Course code : RPEC 102:				
Course Name : Research and Publication Ethics (RPE)				
Semester /Year : 2021-2022				
Subject specific Core Paper	L	T	P	C
Paper II:	1	1	0	2

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

This course aimed is to aware the students about the basic ethics of research and publication. The contents will serve as basic tools to groom the students about plagiarism in research.

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

Theory

RPE 01 Philosophy and Ethics	03 **Hours**
RPE 02 Scientific Conduct	05 **Hours**
RPE 03 Publication Ethics	07 **Hours**

Practice

RPE 04 Open Access publishing	04 **Hours**
RPE 05 Publication Misconduct	04 **Hours**
RPE 06 Databases and Research Metrics	07 **Hours**
Total	**30 Hours**

Theory

- **RPE 01 Philosophy and Ethics (3 Hours)**

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

- **RPE 02 Scientific Conduct (5 Hours)**

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

- **RPE 03 Publication Ethics (7 Hours)**

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

7. Predatory publishers and journals

Practice

- **RPE 04: Open Access Publishing (4 Hours)**

1. Open access publications and initiatives
2. SHERPA / RoMEO online resource to check publisher copyright and self-archiving policies
3. Software tools to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

- **RPE 05: Publication Misconduct (4 Hours)**

A. Group Discussion (2 Hours)

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

B. Software tools (2 Hours)

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

- **RPE 06 :Databases and Research Metrics (7 Hours)**

A. Databases (4 Hours)

1. Indexing databases
2. Citation databases: Web of Science, scopus, etc.

B. Research Metrics (3 Hours)

1. Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score
2. Metrices: h-index, g index, i10 index, altmetrics.

Suggested Readings:

1. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance, 2019, ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf
2. Chaddah, P., Ethics in Competitive Research: Do not get scooped; do not get plagiarized 2018, ISBN:978-9387480865.
3. Beall, J. Predatory publishers are corrupting open access, Nature, 489 (7415), 179-179, 2012. https://doi.org/10.1038/489179a
4. Resnik, D. B., What is ethics in research and why is it important, National Institute of Environmental Health Sciences, 1-10. Retrived from https://www.neihs.nih.gov/research/resources/bioethics/whatis/index.cfm 2011.
5. National Academy of Sciences, National Academy of Engineering and Institute of Medicine, On Being a Scientist: A Guide to Responsible Conduct in Research: 3rd edition , National Academics Press 2009.
6. Bird, A., Philosophy of Science, Routledge 2006.
7. MacIntyre, A., A Short History of Ethics, London 1967.

Course Outcomes:

After completion of the course, the student should be able to:

CO1. Understand the basic ethics of research.
CO2. Maintain the research integrity and intellectual honesty.
CO3. Understand the scientific misconduct and proper citations.
CO4. Acquire knowledge of databases and software's.

COURSE NAME: TOOLS & TECHNIQUE

Course code : PMTC 103				
Course Name : Tools & Technique				
Semester /Year : 2021-2022				
Subject specific Core Paper	L	T	P	C
Paper III:	2	1	1	4

Course Objectives:

This course aimed is to aware the students about the formulating a research problems write a literature survey, study a scientific paper, publishing a research paper, presentations skills and use of presentation tools.

Unit -1 Formulating Problem Statement :

Overview of research process: Formulating the Research Problem, Extensive Literature Review, Developing the objectives, preparing the Research Design including Sample Design, Collecting the Data, Analysis of Data, Generalization and Interpretation, preparation of the Report or Presentation of Results-Formal write-ups of conclusions reached.

Problem statement – Conditions and steps in selecting a research problem, Understanding the Key research area of interest, How to get new ideas (Criticizing a paper), finding a good problem: Top-down and Bottom-up approach, Creative thinking techniques, coming up with a problem statement

Defining objectives – How to find objectives, characteristics of objectives.

Unit -2 Literature survey :

Overview – What is literature survey, Functions of literature survey, maintaining a notebook, developing a Bibliography Methods of data collection – Observation, survey, contact methods, experimental, determining sample design

Searching for publications – Publication databases, search engines and patent databases, Find some/all of the references for a given paper, including those that are not on the web Online tools – Google, CiteSeer, ACM Digital Library, IEEE, The on-line Computer Science bibliography, Survey papers, Finding material not on the web, Searching patents.

Unit -3 How to study a scientific paper :

Summarizing paper – Reading abstracts and finding ideas, conclusion, Advantages of their approach, the drawbacks of the papers (What is lacking – can be found in the sections such as future work) Generalize results from a research paper to related research problems Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject.

Unit -4 Publishing a paper :

How to write scientific paper - Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper: Abstract writing, chapter writing, discussion,

conclusion, references, bibliography, and In-class discussion of technical writing examples, Poster papers, review papers, how to organize thesis/ Project report, How to write a research proposal? How research is funded? Research ethics – Legal issues, copyright, plagiarism General advice about writing technical papers in English - Tips for writing correct English.

Unit -5 How to present scientific paper :

Talk structure, basic presentations skills. Documentation and presentation tools – LATEX, Microsoft office, PowerPoint and SLITHY.

Suggested Readings:

1. George Grätzer, *More Math Into LaTeX*, 5th edition, (2016) Springer.
2. Gary B. Shelly, Misty E Vermaat, and Thomas J. Cashman, Microsoft Office 2007: Introductory Concepts and Techniques. South-Western College Publishing; Spi Pap/Dv edition (3 September 2010)
3. Diana Ridley, The Literature Review, Second Edition, SAGE Publications Ltd 2012.

Course Outcomes:

CO1.	Basic of formulation of the problems, how to understand and finding a good problem, How to find objectives
CO2.	How to write literature survey and how to use Online tools – Google, CiteSeer, ACM Digital Library, IEEE
CO3.	How to study a scientific paper, Generalize results from a research paper to related research problems Comparing the approach

CO4.	How to write scientific paper, review papers, how to organize thesis etc
CO5.	To understand the basic of presentations skills and presentation tools – LATEX, Microsoft office, PowerPoint and SLITHY

COURSE NAME: ADVANCED NUMERICAL METHODS

Course code : PMTE 104				
Course Name : ADVANCED NUMERICAL METHODS				
Semester /Year : 2021-2022				
Subject specific Elective Paper	L	T	P	C
Paper I	2	1	1	4

Course Objectives:

This course aimed to develop the basic skills of research students on numerical methods to applied in application of mathematics. The topics introduced will serve as basic tools for specialized studies in many fields of mathematics.

Unit – 1 Errors

Errors and Interpolation, Errors and their computation,
Absolute, Relative and Percentage Errors, Errors in series Approximation.

Unit – 2 Interpolation

Interpolation Gauss Central Difference Formulae, Stirling, Bessel Formula, Lagranges Interpolation and Newton Divided Difference Formula, Cubic Spline interpolation, Inverse Interpolation, Method of Successive Approximations.

Unit – 3 Numerical Solutions of ordinary Differential Equations

Solution by Taylor's, Series, Picard method of Successive Approximations, Euler's Method, Runge-Kutta Methods, Predictor- Corrector Methods.

Unit – 4 Solutions of Simultaneous Algebraic Equations

Jacobi's Iteration Method, Gauss Seidal Iteration Method, Eigen values by Power method, Jacobi's method and given's method.

Unit – 5 Numerical Solutions of Partial Differential Equations

Introduction, Classification of second order equations. Finite Difference Approximations to derivatives. Laplace Equation Jacobi's and Gauss- Seidal Method, Parabolic Equations. Numerical Solution of Integral Equations by Finite- Difference Methods, Chebyshev Series Method, Cubic Spline Method.

Suggested Readings:

1. Gupta, R. K., Numerical Methods: Fundamentals and Applications, Cambridge University Press, 2019.
2. Strikwerda, J. Finite Difference Schemes and Partial Differential Equations, Second Edition, SIAM, 2004.
3. Butcher, J. C.; Numerical Methods for Ordinary Differential Equations, 2nd ed., Wiley, 2003.
4. Jain, M. K., Numerical Solution of Differential Equations. New Age International (P) Ltd, 2003.
5. S. K. Godunov and V. S. Ryabenki, Difference Schemes: an introduction to the underlying theory, North Holland, 1987.
6. LeVeque, R. J., Finite Difference Methods for Ordinary and Partial Differential Equations, Steady State and Time Dependent Problems, SIAM, 2007.
7. Iserles, I., A First Course in the Numerical Analysis of Differential Equations, Cambridge University Press, 1996.

Course Outcomes:

After completion of the course, the students will be able to
CO1. understand the Errors and Interpolation and their types.
CO2. Understand the basic of Interpolation Gauss Central Difference Formulae, Stirling, Bessel Formula, Lagranges Interpolation and Newton Divided Difference Formula, Cubic Spline interpolation, Inverse Interpolation, Method of Successive Approximations.
CO3. Implement the advanced aspects of various methods like as Taylor's Series method, Picard method of Successive Approximations, Euler's Method, Runge-Kutta Methods, Predictor- Corrector Methods to solve the differential equations.
CO4. Understand the Jacobi's Iteration Method, Gauss Seidal Iteration Method, and how to find the Eigen values by Power method, Jacobi's method.
CO5. Basic of Classification of second order equations understand the Finite Difference Approximations to derivatives and how to apply Jacobi's and Gauss- Seidal Method, and use Finite- Difference Methods to solve numerical Solution of Integral Equations, and about the Chebyshev Series Method, Cubic Spline Method.

COURSE NAME: MATHEMATICAL MODELING

Course code : PMTE 105				
Course Name : MATHEMATICAL MODELING				
Semester /Year : 2021-2022				
Subject specific Elective Papers	L	T	P	C
Paper II	2	1	1	4

Course Objectives:
This course aimed to develop the basic of mathematical models for different applications.

Unit- 1
Principles of making mathematical models, multistage rockets, satellite orbits, Microbial growth in a chemo stat and its stability, growth of microbial population, products formation due to microbial action, competition for a growth-rate limiting substrate in a chemo stat, stability of equilibrium positions, Batch culture case.

Unit- 2
Simple logistic models, generalized logistic models, logistic model for a non-isolated population. A simple prey-predator model, other prey-predator models, models for competition.

Unit- 3
Logistic model with constant harvesting rate, growth of predator-prey populations with harvesting.

Unit- 4
Simple deterministic model, SIS model, SIS model with constant number of carriers, simple epidemic model with carriers, General deterministic model with removal, General deterministic model with removal and immigration, control of epidemic.

Unit- 5
Models for blood flows, Basic concepts about blood, Cardiovascular system and blood flows, Newtonian Pulsatile flows in rigid and elastic tubes, Pulsatile flow in elastic tube. Blood flow through artery with mild stenosis. Two dimensional flow in renal tubule. Simple diffusion and diffusion – reaction models.

Suggested Readings:

- Bender, E. A. (2012). An introduction to mathematical modeling. Courier Corporation.
- Dym, C. (2004). Principles of mathematical modeling. Elsevier.
- Kapoor, J.N., Mathematical Modelling, Wiley Eastern limited

Course outcomes:
After completion of the course, students will be able to
CO1. How to understand Principles of making mathematical models to multistage rockets, satellite orbits, Microbial growth in a chemo stat and its stability, growth of microbial population.
CO2. Understand the Simple logistic models, generalized logistic models
CO3. Understand the Logistic model with constant harvesting rate, growth of predator-prey populations with harvesting.
CO4. Basic of SIS model with constant number of carriers, simple epidemic model with carriers, General deterministic model with removal, General deterministic model with removal and immigration, control of epidemic.
CO5. Understand the basic concepts, mathematical modeling in biological systems. Create models for real life problems.

COURSE NAME: DIFFERENTIAL GEOMETRY

Course code : PMTE 106				
Course Name : DIFFERENTIAL GEOMETRY				
Semester /Year : 2021-2022				
Subject specific Elective Papers	L	T	P	C
Paper III	2	1	1	4

Course Objectives:
This course aimed understand basic and the research skills to pursuing research in above mentioned topics

Unit- 1 Tensor calculus:
spaces of n dimensions, contra variant and covariant tensors. Addition and multiplication of tensors, Contradiction, quotient law, Riemannian metric and fundamental christoffel symbols, covariance differentiation. Riemannian curvature tensor. Bianchi's identity. Ricci tensor, sectional curvature, Sehuri's theorem.

Unit- 2 Curves in space:
Arc length, tangent, osculating plane, normal plane, principal plane and binormal, curvature and torsion, serret-frenet formulae, osculating sphere, spherical indicatrices, involuties and evolutes, Helices.

Unit- 3 Surfaces in R^3 :
Surfaces, surfaces of revolution, Helicoids, families of curves on a surface, first and second fundamental form of a surface, principal directions, limits of curvature, principal curvature and Gaussian curvature, Dupin's indicatrix, normal curvature, conjugate directions , Asymptotic lines, Developables, minimal surfaces, Rulet surfaces, Gauss and Weingarten formulae, Gauss equations, Mainardi-codazzi's equations, Geodesics, Geodesics on surfaces of revolution, Geodesic curvature of a curve.

Unit- 4
Projective and conformal transformation: Reimannian spaces in geodesic correspondence. Weyl's projective curvature tensor and into properties. Conformal transformation of Reimannian spaces, conformal curvature tensor and its properties. Lie derivative, motion and affine motion in a Riemannian space.

Unit- 5
Differentiable manifolds: Definition and examples, Tangent space, vector field, Lie bracket, Koszul connection, covariant differential Torsion and curvature tensors. Identities satisfied by curvature and torsion tensors, Riemannian connection.

Books Recommended

1. J.J. Willmore: An Introduction to Differential Geometry; Oxford University Press, 1989.
2. L. P. Eisehart: An Introduction to Differential Geometry, Princeton University Press, 1940.
3. C. E. Weatherbum: An Introduction to Reimannian Geometry and the Tensor Calculus, Cambridge University Prcos, 1966.
4. Nirmala Prakash: Differential Geometry- An Integrated Approach, Tata Mcgraw Hill, 1981.
5. T. J. Willmore: Riemannian Geo, Oxford University Press , 1997.
6. R. S. Sinha: Differential Geometry of three dimensions, Chandra Prakashan, 1988.
7. **S. S.** Chern, W. H. Chen and K. S. Lam, Lectures on Differential Geometry, World Scientific Publishing Co. Pvt. Ltd., 2000.
8. N. J. Hicks, Notes of Differential Geometry, D. Van Nostrand Reinhold Company, New York, 1965.
9. W. M. Boothby, An Introduction to Differentiable Manifolds and Riemannian Geometry, 2nd Edition, Academic Press, New York, 2003.

10. S. Kumaresan, A Course in Differential Geometry and Lie Groups (Texts and Readings in Mathematics), Hindustan Book Agency, 2002.
11. W. M. Boothby, An Introduction to Differentiable Manifolds and Riemannian Geometry, 2nd edition, Academic Press, New York, 2003.

Course outcomes:

After completion of the course, students will be able to

CO1. How to understand the basic concepts of differential geometry and know the Riemannian curvature tensor. Bianchi's identity. Ricci tensor, sectional curvature, Sehuri's theorem

CO2. Understand the Curves in space, osculating plane, normal plane, principal plane, serret-frenet formulae, osculating sphere, spherical indicatrices etc.

CO3. Understand the Surfaces, surfaces of revolution, Helicoids, families of curves on a surface

CO4. Understand the Projective and conformal transformation, Reimannian spaces, Lie derivative and related

CO5. Understand the basic concepts Differentiable manifolds and its related.

COURSE NAME: FUZZY LOGIC AND ITS APPLICATIONS

Course code : PMTE 107				
Course Name : FUZZY LOGIC AND ITS APPLICATIONS				
Semester /Year : 2021-2022				
Subject specific Elective Paper	L	T	P	C
Paper IV	2	1	1	4

Course Objectives:
This course aimed to understand basic and the research skills to pursuing research in fuzzy logic and its applications.

Unit- 1
Introduction:
A case for imprecision, a historical perspective. The utility of fuzzy system, limitations of fuzzy systems sincerenity and information, sets as points in hypercube. Fuzzy sets and memberships.

Unit- 2
Classical sets and fuzzy sets: operations and properties classical relations and fuzzy relations: operations and properties, cardinality tolerance and equivalence relations. Fuzzy arithmetic and extension principle.

Unit- 3
Properties of membership functions fuzzification and defuzzification. Logic and fuzzy systems: fuzzy logic, approximate reasoning natural language, linguistic hedges, fuzzy (rule based) systems, graphical techniques of interface.

Unit- 4
Fuzzy systems simulations: fuzzy relational equations, nonlinear simulation using fuzzy systems. Fuzzy associative memories (FAMs).

Unit- 5
Decision making with fuzzy information: fuzzy synthetic evaluation, fuzzy ordering, preferences and consensus, no transitive ranking, multi objective decision making, decision making under fuzzy states and fuzzy actions.

Reference Books

1. Ross, T. J. (2017) Fuzzy logic with engineering applications. 4th ed., (An Indian Adaptation) Wiley.
2. Ross, T. J. (2017) Fuzzy logic with engineering applications. 4th ed., John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.
3. Klir, G. J., and Yuan, B. (2008). Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall.
4. Yen, John., and Reza. Langari. (1999) Fuzzy Logic : Intelligence, Control, and Information / John Yen and Reza Langari. Upper Saddle River, N.J: Prentice Hall.
5. Dubois, D., & Prade, H. (1980). Fuzzy sets and systems: theory and applications. *Mathematics in science and engineering* vol. 144, Academic Press, New York.
6. Negoita, C.V. (1988), Fuzzy sets, uncertainty and information, by George J. Klir and Tina A. Folger, Prentice Hall, Englewood Cliffs, NJ, 1988. Syst. Res., 5: 355-356. https://doi.org/10.1002/sres.3850050411

Course outcomes:

After completion of the course, students will be able to

CO1. How to understand the utility of fuzzy system Fuzzy sets

CO2. Understand the fuzzy relations, Fuzzy arithmetic and extension principle.

CO3. Understand the Logic and fuzzy systems

CO4. Understand the fuzzy relational equations, nonlinear simulation using fuzzy systems

CO5. Understand the basic of Decision making with fuzzy information.