Dissertation (19M27MA211)

Course Code	19M27MA211	**Semester** Even **(specify Odd/Even)**	**Semester IV Session** 2021 -2022 **Month from:** January to June 2022
Course Name	Dissertation		
Credits	10	**Contact Hours**	
Faculty (Names)	**Coordinator(s)**	Dr. Pato Kumari	
	Teacher(s) (Alphabetically)	Dr. Pato Kumari	

COURSE OUTCOMES: After completion of the dissertation, student will be able to		**COGNITIVE LEVELS**
C250.1	understand the research-oriented problems and related areas.	Understanding Level (C2)
C250.2	organize the literature to form a problem in said area of study.	Applying Level (C3)
C250.3	develop the solution of the problem.	Applying Level (C3)
C250.4	analyze findings in terms of a report.	Analyzing Level (C4)

Employability: In this course, the students will be working on research problems in various fields of pure and applied Mathematics as per their specialization. The students will be able to learn to use the latest methods/techniques/tools/softwares to achieve the defined objectives of their dissertation. This will help the students to develop mathematical and scientific research temperament which will be beneficial for their future academics and research endeavors.

Module No.	**Topics in module**
1	Identification of the dissertation problem and literature review in the related field and explore experimental and theoretical tools/ techniques/software/hardware.
2	Acquire knowledge and analyze various methods/techniques to be used in solving the defined problem and find a suitable methodology.
3	Utilize latest techniques/software/hardware tools to achieve the proposed objectives and obtain results. Evaluation/analysis of the obtained results and their interpretation.

Evaluation Criteria

Components	**Maximum Marks**
Day to Day Evaluation	40 (To be awarded by supervisor)
End Term Evaluation	50 (To be awarded by a panel of 3 examiners)
Special Contribution	10 (To be awarded by a panel of 3 examiners)
Total	**100**

Number Theory (21M22MA211)

Course Description

Course Code	**21M22MA211**	**Semester Even**	**Semester IV Session** 2020-21 **Month from** Jan - Jun 2021
Course Name	Number Theory		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Neha Singhal	
	Teacher(s) (Alphabetically)	Dr. Neha Singhal	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C233.1	explain the concepts of divisibility and congruence.	Understanding Level (C2)
C233.2	apply the number theoretic functions and primitive roots in cryptosystem.	Applying Level (C3)
C233.3	make use of quadratic residues in various applications.	Applying Level (C3)
C233.4	analyze Pell's equation and Fermat's last theorem using continued fractions.	Analyzing Level (C4)
C233.5	examine Riemann Zeta function, Dirichlet L-function and Euler product formula.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Some concepts on Divisibility**	Divisibility, the greatest common divisor, the fundamental theorem of arithmetic Euclid's algorithm, coprime integers, the least common multiple: definition and properties, linear Diophantine equations, prime number theorem (statement only), conjectures, Fermat and Mersenne primes, residue classes and reduced residue systems	**5**
2.	**Congruences**	Linear congruence, Wilson's Theorem, Fermat's Theorem, pseudo primes and Carmichael numbers, Chinese remainder theorem.	**3**

3.	**Number Theoretic Function and Cryptography**	Euler phi function, arithmetic function, multiplicative functions, Mobius function, Mobius inversion formula, perfect numbers, characterization of even perfect numbers, RSA Cryptosystem.	**8**
4.	**Primitive roots**	order of an integer, primitive roots, characterization of integers for which a primitive root exists, composite numbers having primitive roots, theory of indices	**6**
5.	**Quadratic residues**	Quadratic residues, Legendre symbol, Euler's criterion, Gauss lemma, law of quadratic reciprocity, definite forms, reduced forms, number of proper representations, automorph, class number	**7**
6.	**Continued Fractions**	Finite continued fractions, recurrence relation, Euler's rule, convergents, infinite continued fractions, representation of irrational numbers, periodic continued fractions and quadratic irrationals,	**4**
7.	**Pell's Equation**	solution of Pell's equation by continued fractions, sum of two and three squares, Waring's problem, sum of four squares, Fermat's Last Theorem	**3**
8.	**Riemann Zeta and Dirichlet L-Function**	Riemann Zeta function, Euler product formula, convergence, applications to prime numbers, Dirichlet L-functions, products of two Dirichlet L-functions.	**6**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: To make subject application based, each student of class studies the application of secure communications techniques that allow only the sender and intended recipient of a message to view its contents in different field. Understanding of encryption/decryption of messages through application of cryptography enhances the student's knowledge and helps the employment in cybersecurity and IT sector and networking.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	**G. A. Jones and J. M. Jones,** *Elementary Number Theory*, Springer UTM, 2012.
2.	**D. M. Burton,** *Elementary Number Theory*, 7th Edition, McGraw-Hill, 2011.
3.	**Niven, H. S. Zuckerman and H. L. Montgomery,** *Introduction to the Theory of Numbers*, Wiley, 2000.
4.	**J. Strayer,** *Elementary Number Theory*, Waveland Press, 2001.
5.	**K. Rosen,** *Elementary Number Theory and its Applications*, 6th Edition, McGraw Hill, 2011.

DATA BASE MANAGEMENT SYSTEM (21M22MA212)

Detailed Syllabus

Lecture-wise Breakup

Course Code	**21M22MA212**	**Semester Even (specify Odd/Even)**	**Semester IV Session** 2021 -2022 **Month from** Jan 2022-June 2022
Course Name	**DATA BASE MANAGEMENT SYSTEM**		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. R. C. Mittal	
	Teacher(s) (Alphabetically)	Dr. R. C. Mittal	

COURSE OUTCOMES: After the successful completion of this course, the student will be able to		**COGNITIVE LEVELS**
C234.1	explain the data base and its relational model.	Understanding Level (C2)
C234.2	explain the data type, key concept, relational algebra and calculus and different operations on a table.	Understanding Level (C2)
C234.3	construct the normalization of a table.	Applying Level (C3)
C234.4	develop SQL and PL SQL programs	Applying Level (C3)
C234.5	analyze concurrent processing of transactions	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Purpose of database system, data models, database languages, database system architecture, entity relationship model, E-R diagrams, introduction to relational database.	5
2.	The Relational Model	The data types, keys, relational algebra, domain relational calculus, tuple relational calculus, fundamental operations, additional operations, views.	5
3.	Functional Dependencies	Non-loss decomposition, functional dependencies – first, second, third normal forms, dependency preservation, Boyce Codd normal form, multi-valued dependencies and fourth normal form, join dependencies and fifth normal form.	8
4.	SQL Fundamentals	Create, modify, update and alter tables. security, advanced SQL features, embedded SQL, dynamic SQL, views creation, access rights.	8

5.	PL/SQL	Basic and advanced concepts, operators, loops, conditional statements, use of cursor, trigger, functions, recursion, procedures.	8
6.	Transaction Concepts	Transaction recovery, acid properties, two phase commit, save points, SQL facilities for recovery, concurrency, need for concurrency, locking protocols, two phase locking, intent locking, deadlock, serializability.	8
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project Based Learning- A group of 3 – 4 students will select one of the small Industrial project such as preparation of results of a university, management of an inventory etc. Each student has to create corresponding Tables, Insert records in the Table in sql and then process the data of the table. Student will also be able to work in a group to understand how to distribute the work and assemble later on.

Recommended Reading material:

1.	A. Silberschatz, H. F. Korth and S. Sudharshan, *Database System Concepts*, Sixth Edition, Tata McGraw Hill, 2011.
2.	C. J. Date, A. Kannan and S. Swamynathan, *An Introduction to Database Systems*, Eighth Edition, Pearson Education (2006).
3.	P. Bhattacharya and A. Majumdar, *Introduction to Database Management Systems*, Tata McGraw Hill (2001). .
4.	I. Bayross**,***SQL and PL-SQL the Programming Languages of Oracle*, BPB Publication, Fourth Revised Edition (2017).

Theory of Data Science (21M22MA213)

Course Code	**21M22MA213**	**Semester** Even **(specify Odd/Even)**	**Semester** IV **Session** 2021-22 **Month from** Jan 2022 - Jun 2022
Course Name	**Theory of Data Science**		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Himanshu Agarwal	
	Teacher(s) (Alphabetically)	Dr. Himanshu Agarwal	

COURSE OUTCOMES: After the successful completion of this course, the student will be able to		**COGNITIVE LEVELS**
C235.1	Explain important terms related to the art of data science.	Understanding Level (C2)
C235.2	make use of various regression techniques for data modeling.	Applying Level (C3)
C235.3	analyze different classification techniques for various datasets.	Analyzing Level (C4)
C235.4	judge quality of dataset based on available information.	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	The art of data Science	Volume, velocity, variety, machine learning, supervised and unsupervised learning, predictions and forecasts, innovation and experimentation, the dark side, big errors, privacy, example, polynomial curve fitting, probability theory, model selection, the curse of dimensionality, decision theory, information theory, regularization and stability, VC dimension.	6
2.	Methods for function approximation:	linear models for regression, parameter estimation methods - maximum likelihood method and maximum a posteriori method, regularization, ridge regression, lasso, bias-variance decomposition, bayesian linear regression	7
3	Classification based on Bayesian decision theory	Bayesian decision theory, Bayes classifier, minimum error-rate classification, normal (Gaussian) density discriminant functions, decision surfaces, maximum-likelihood estimation, maximum a posteriori estimation, Gaussian mixture models expectation-maximization method for parameter estimation, naive Bayes classifier.	6
4	Classification based on non parametric techniques	Non-parametric techniques for density estimation, Parzen-window method, k-nearest neighbors method, logistic regression, perceptron,	5

5	Sequential pattern classification	Hidden Markov models (HMMS) for sequential pattern classification discrete HMMS and continuous density HMMS	5
6	Boosting of classifiers	Support vector machine, decision trees, bagging, boosting, gradient boosting	5
7.	Dimensionality reduction	Principal component analysis, partial least squares, factor analysis, fisher discriminant analysis, multiple discriminant analysis.	4
8.	Extracting information from news	Algorithms, extracting data from web sources using APIs, text classification, metrics, grading text, text summarization.	4
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials,Project)
Total	**100**

Recommended Reading material:

Project based learning: Students in a small group will collect sample data set and make classification models. They will validate the model by various selection and assessment methods. By this students will be able to make classification models and validate it

1.	**E. Alpaydin,***Introduction to Machine Learning*, 2nd Ed., PHI Learning 2012.
2.	**C. M. Bishop,***Pattern Recognition and Machine Learning*, Springer 2013.
3.	**T. Hastie, R. Tibshirani and J. Friedman,***The Elements of Statistical Learning*, 2nd Ed., Springer 2008
4.	**S. R. Das,***Data Science Theories, Models, Algorithms, and Analytics*, Apache License, 2016
5.	**S. S. Shwartz and S. B.David,** *Understanding Machine Learning: from Theory to Algorithms*, Cambridge University Press, 2014
6.	**R.O.Duda, P.E.Hart and D.G.Stork,** Pattern Classification, John Wiley, 2001