DEPARTMENT OF MATHEMATICS
BIRLA INSTITUTE OF TECHNOLOGY
MESRA: RANCHI

Date: 16/11/2021

Ref.- Dept/Math/2021-2022/79

To,

The Dean (UG)

BIT, Mesra, Ranchi

Sub: Submission of revised CBCS course structure and BOS minutes for your approval.

Dear Sir,

Please find the attached herewith the revised CBCS Coures structure and minutes of the meeting 16.11.2021.

Thanking you,

Yours Sincerely,

(Dr. S. Padhi)

Chairman, BOS

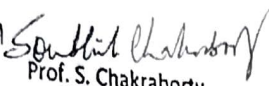Prof. & Head

BIRLA INSTITUTE OF TECHNOLOGY
MESRA: RANCHI

Date: 16/11/2021

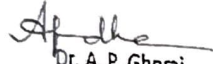Ref: – Dept /Math/2021-2022/78

MINUTES OF THE BOS MEETING

A meeting of the Board of Studies (BOS) members was held at 2:00 PM on 16.11.2021 by virtual mode. The BOS members rigorously discussed and approved the revised course structure for IMSc. (Mathematics and Computing), and the revision of MA108 (Mathematics III) & MA207 (Mathematics IV) to MA108R1 (Mathematics III) and MA207R1 (Mathematics IV) by adding course contents less than 10%, The revision of MA108 &MA207 are carried out as per the requirements of Dept. of Physics. & Dept. of Chemistry dept. for their IMSc. students.

Prof. S. K. Jain
(Member)
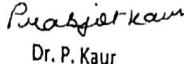
Prof. S. Chakraborty
(Member)
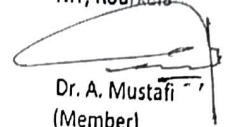
Prof. S. Konar
(Member)
Dept. of Physics
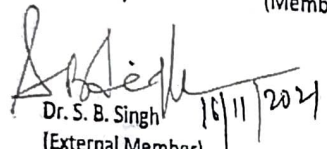
Prof. G. K. Panda
(External Member)
Dept. of Mathematics
NIT, Rourkela
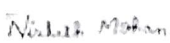
Dr. A. P. Ghorai
(Member)
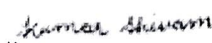
Dr. A. Tandon
(Member)
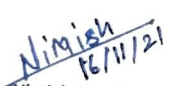
Dr. P. Kaur
(Member)

Dr. A. Mustafi
(Member)
Dept. of Comp. Sc. & Engg.

Dr. S. B. Singh
(External Member)
Asso. Prof. Biostat, PSM,
RIMS, Ranchi
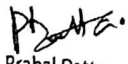
Nishith Mohan
(Member Alumni) ,Research scholars
Dept. of Mathematics, IIT Mandi,
Himachal Pradesh 175005
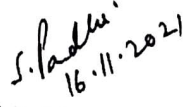
Kumar Shivam
(Member Alumni)
Data Scientist Flipshope
Bengaluru, Karnataka 560102

Nimish Tiwari
(Member Student)
IMSc. (Maths & Computing)
3rd Year (VIth Semester

Swapnil Kant
(Member Student)
IMSc. (Maths & Computing)
4th Year (VIIIth semester)

Peeyush Tewari
(Inv. Member)

Dr. Prabal Datta
(Inv. Member)

(Prof. S. Padhi)
Chairman, BOS
Department of Mathematics
Prof. & Head,

Copy to
1. PS to VC
2. Registrar
3. Dean AP
4. All Members

Course code: MA108R1
Course title: Mathematics III
Pre-requisite(s): 10+2 Mathematics
Co- requisite(s): ---
Credits: L: 5   T: 1   P: 0   C: 6
Class schedule per week: 5 Lectures, 1 Tutorial.
Class: IMSc
Semester / Level: II / 1
Branch: Physics and Chemistry
Name of Teacher:

Course Objectives: This course enables the students to understand

1.	infinite sequences and series
2.	theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
3.	Multivariable functions, their limits, continuity, partial differentiation, properties and applications of partial derivatives.
4.	integrals of multivariable functions viz. double and triple integrals with their applications
5.	properties like gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions

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

CO1	decide the behaviour of sequences and series using appropriate tests.
CO2	handle problems related to the theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
CO3	get an understanding of partial derivatives and their applications in finding maxima - minima problems
CO4	apply the principles of integrals (multivariable functions viz. double and triple integrals) to solve a variety of practical problems in engineering and sciences
CO5	get an understanding of gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions and demonstrate a depth of understanding in advanced mathematical topics, enhance and develop the ability of using the language of mathematics in engineering

16.11.2021

1

MA108R1   **Mathematics – III**   **5-1-0-6**

MODULE – I: Sequences and Series

Infinite Sequences, Convergence of Sequences, Infinite series, Convergence of Infinite Series, Tests for Convergence: Comparison tests, Ratio test, Cauchy's root test, Raabe's test, Logarithmic Test, Gauss test, Cauchy's Integral test, Alternating series, Leibnitz test, Absolute and Conditional Convergence.   [12 L]

MODULE – II: Matrix Theory

Determinants, Types of Matrices, Inverse of Matrix, Elementary Transformations, Rank of a Matrix, Row - reduced Echelon form, Normal From, Vectors, Linear Independence and Dependence of Vectors, System of linear equations. Introduction to Linear Transformations, Eigenvalues, Eigenvectors, Cayley - Hamilton theorem, Diagonalization, Quadratic forms and its different properties.   [12 L]

MODULE – III: Differential Calculus

Function of several variables, Limit, Continuity, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Chain rules, Jacobians and its properties, Taylor series for function of two variables, Maxima, Minima and Saddle Points, Lagrange's method of multipliers.   [12 L]

MODULE – IV: Integral Calculus

Beta and Gamma function along with their properties. Double integrals, double integrals in polar coordinates, Change of order of integration, Triple Integrals, cylindrical and spherical coordinate systems, transformation of coordinates, Applications of double and triple integrals in areas and volumes.   [12L]

MODULE – V: Vector Analysis

Space curves, Vector valued functions, derivative of vector valued functions, tangent, normal and binormal, curvature, torsion, Frenet Formulae. Point functions, scalar and vector point functions, gradient, directional derivative, divergence, curl, vector equations and identities. Line Integral, Work done, Conservative field, Green's theorem in a plane, Surface and volume integrals, Gauss – divergence theorem, Stoke's theorem. Introduction to Curvilinear Coordinates.   [12 L]

Text Books:
1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. H. Anton, I. Brivens and S. Davis, Calculus, 10th Edition, John Wiley and sons, Singapore Pte. Ltd., 2013.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.

Reference Books:
1. M. J. Strauss, G. L. Bradley And K. J. Smith, Calculus, 3rd Ed, Dorling. Kindersley (India) Pvt. Ltd. (PEd), Delhi, 2007.
2. M. D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 11th edition, Pearson Educations, 2008.
3. S.C. Malik and S. Arora, Mathematical Analysis, New Age International, 1992.
4. David C. Lay, Linear Algebra and its Applications (3rd Edition), Pearson Ed. Asia, Indian Reprint, 2007.
5. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, Fourth Edition, 2011.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Making students solve engineering problems using the studied concepts.
2. Experimentally visualising the analytical concepts.
3. Difficult to produce extensive proves of the state of the art definitions and theorems.

POs met through Gaps in the Syllabus

3, 4, 12

Topics beyond syllabus/Advanced topics/Design

1. Proofs of the said theorems
2. For students to come up with innovative ideas and carry out project works during the running semester is beyond syllabus
3. Industrial visits to train them of the challenges in the industry and support students to do Projects atindustries

POs met through Topics beyond syllabus/Advanced topics/Design

2, 3, 4, 12

Course outcome (co) attainment assessment tools & evaluation procedure

Direct assessment

Assessment tool	% contribution during co assessment
Mid semester examination	25
End semester examination	50
Quiz (s)	10+10
Assignment	5

Assessment components	CO1	CO2	CO3	CO4	CO5
Mid semester examination	√	√	√		
End semester examination	√	√	√	√	√
Quiz (s)	√	√	√		
Assignment	√	√	√	√	

Indirect assessment –

1. Student feedback on course outcome

Mapping of course outcomes onto program outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	2	1	1	1	1	3	3	2	2	2	3	3
CO2	3	2	2	2	1	1	2	1	3	3	2	2	2	3	3
CO3	3	3	2	2	1	1	1	1	3	3	2	2	2	3	3
CO4	2	2	3	1	1	1	1	1	3	3	2	2	2	3	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium)   3: Substantial (High)

If satisfying< 34%=1, 34-66% =2, > 66% = 3

CD Code	Course delivery methods
CD1	Lecture by use of boards/lcd projectors/ohp projectors
CD2	Tutorials/assignments
CD3	Seminars
CD4	Mini projects/projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of nptel materials and internets
CD9	Simulation

Mapping Between COs and Course Delivery (CD) methods

Course Outcome	Course Delivery Method Used
CO1	CD1, CD7, CD 8
CO2	CD1 and CD9
CO3	CD1, CD2 and CD3
CO4	CD1 and CD2
CO5	CD1 and CD2

16.11.2021

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COURSE INFORMATION SHEET

Course code: MA 207R1

Course title: Mathematics IV

Pre-requisite(s): Mathematics - III

Co- requisite(s): ---

Credits: L: 5 T: 1 P: 0 C: 6

Class schedule per week: 5 Lectures, 1 Tutorial.

Class: IMSc

Semester / Level: IV / 2

Branch: Physics and Chemistry

Name of Teacher:

Course Objectives: This course enables the students to understand

1.	various methods to solve linear differential equations of second and higher order
2.	special functions viz. Legendre's and Bessel's and different properties associated with them
3.	diverse mathematical techniques for solving partial differential equations of first order and higher order, along with their applications in wave and heat equations using Fourier series
4.	the theory of functions of a complex variable, complex differentiation and integration
5	infinite series (Taylor and Laurent series) for complex variable function, the theory of residues with applications to evaluation of integrals

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

CO1	investigate the occurrence of differential equations in science and engineering and the methods available for their solutions.
CO2	formulate any real life problem in terms of special functions associated with differential equations.
CO3	gain an understanding of solving problems associated with partial differential equations
CO4	gain an understanding on complex variable function, analytic functions and their properties using different theorems and demonstrate a depth of understanding in advanced mathematical topics
CO5	enhance and develop the ability of using the language of mathematics in science and engineering

Syllabus

MATHEMATICS – IV

5-1-0-6

MA 207R1

MODULE – I: Ordinary Differential Equations

First order differential equations and their applications. Separation of variables, equations reducible to separable form. Linear differential equations, Wronskian, Linear independence and dependence of solutions, Linear differential equations of second and higher order, Operator method, Euler – Cauchy's differential equation, Legendre's linear differential equation, Method of variation of parameters.   [12L]

MODULE – II: Series Solution and Special Functions

Power series, ordinary and singular points of differential equation, Power and Frobenius series solutions, Bessel's differential equation and its series solution, Bessel function of first kind and its properties, Legendre's differential equation and its series solution, Legendre's polynomial and its properties.   [12L]

MODULE – III: Integral Transforms and Partial Differential Equations

Laplace transforms, its properties and its applications, Fourier series, Euler formulae for Fourier series for length of interval 2π, Fourier series for arbitrary length of interval, Half range Fourier series, Fourier transforms and its properties.

Linear and quasi – linear partial differential equations, Lagrange's method, Method of separation of variables and its application in solving one dimensional wave and heat equations   [12L]

MODULE – IV: Complex Analysis - I

Function of a complex variable, Limit, Continuity, Differentiability, Analyticity, Analytic functions, Cauchy – Riemann equations (Cartesian and Polar form). Complex Integration, Cauchy's theorem, Cauchy's Integral formula, Cauchy's Integral Formula for derivatives   [12L]

MODULE – V: Complex Analysis - II

Power series, Radius of convergence, Taylor and Laurent series for complex variable functions, Singularities and its types, Residues, Residue theorem and its applications.   [12L]

Text Books:
1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
3. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, Fourth Edition, 2011.
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
5. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing, Third Edition,   2009

Reference Books:
1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value
2. Problems, 9th Edition., Wiley India, 2009.
3. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

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4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

5. G. F. Simmons, Differential Equations with Applications and Historical Notes, TMH, 2nd ed.,2003.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Applications of differential equations in diverse real life problems.
2. Different mappings of complex variable functions and use of complex variable theory in theory offunctions of real variables

POs met through Gaps in the Syllabus:

2, 3, 9

Topics beyond syllabus/Advanced topics/Design: NA

POs met through Topics beyond syllabus/Advanced topics/Design: NA

Course outcome (co) attainment assessment tools & evaluation procedure

Direct assessment

Assessment tool	% contribution during co assessment
Mid semester examination	25
End semester examination	50
Quiz (s)	10+10
Assignment	5

Assessment components	CO1	CO2	CO3	CO4	CO5
Mid semester examination	√	√	√		
End semester examination	√	√	√	√	√
Quiz (s)	√	√	√		
Assignment	√	√	√	√	

Indirect assessment –
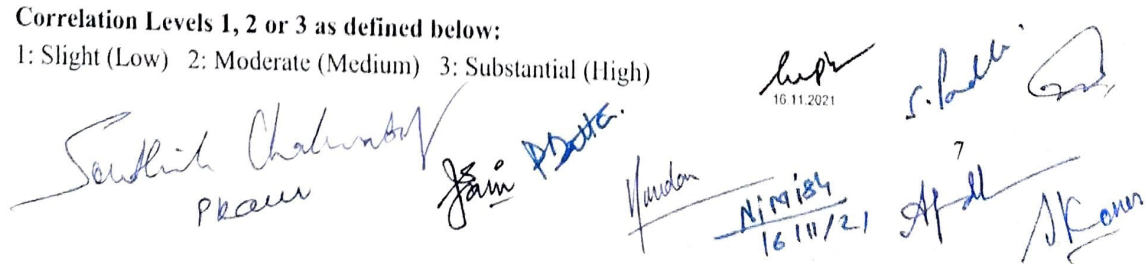
1. Student feedback on course outcome

Mapping of course outcomes onto program outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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16.11.2021

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CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of nptel materials and internets
CD9	Simulation

Mapping between COs and Course Delivery (CD) methods

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2
CO2	CD1, CD2
CO3	CD1, CD2
CO4	CD1, CD2
CO5	CD3

16.11.2021

8

BIRLA INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM
(Effective from Academic Session: Monsoon 2021)

PROGRAMME
5 Years Integrated Master of Science in Mathematics and Computing

16.11.2021

Department of Mathematics

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

Institute Mission

- To educate students at Under Graduate, Post Graduate, Doctoral, and Post-Doctoral levels to perform   challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research
    projects.

- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emergingareas.
- To provide excellent technological services to satisfy the requirements of the industry and overall
academic needs of society.

Department Vision

- To become a globally recognized centre of excellence in teaching and research, producing excellent academicians, professionals and innovators who can positively contribute towards the
    society.

Department Mission

- Imparting strong fundamental concepts to students in the field of Mathematical Sciences and motivate them towards innovative and emerging areas of research.
- Creation of compatible environment and provide sufficient research facilities for undertaking   quality
    research to achieve global recognition.

CBCS based Syllabus for IMSc in Mathematics and Computing
(1st -10th Semester)

Important notes:

> The basic criteria of UGC have been followed in preparing the course structure of this programme.
> The Exit option with B.Sc. Honours in Mathematics and Computing can be offered to them who want to get it after successful completion of 6th semester.
> Otherwise IMSc in Mathematics and Computing would be offered to them after the successful completion of 10th semester.

Graduate Attributes

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis**: Identify, formulate, research literature and analyze complex engineering problems
reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

4. **Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
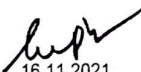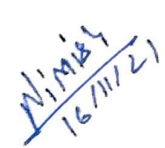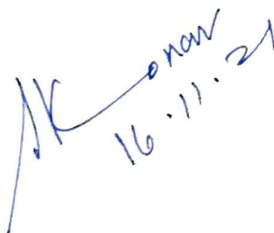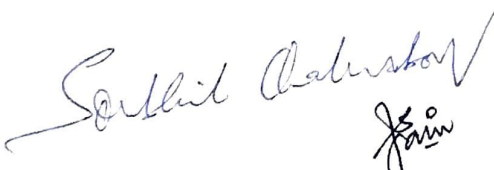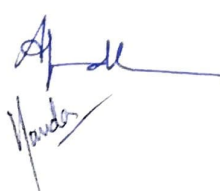
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7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

16.11.2021

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Program Educational Objectives (PEOs)

1. To impart conceptual knowledge of Mathematical Sciences for formulating and analyzing the real-world problems with futuristic approach.
2. To equip the students sufficiently in both analytical and computational skills in Mathematical Sciences.
3. To develop a competitive attitude for building a strong academic - industrial collaboration, with focus on continuous learning skills.
4. To nurture and nourish strong communication and interpersonal skills for working in a team with high moral and ethical values.

A) Programme Outcomes (POs)

A graduate of this program is expected to:

1. gain sound knowledge on fundamental principles and concepts of Mathematics and computing with their applications related to Industrial, Engineering, Biological and Ecological problems.
2. exhibit in depth the analytical and critical thinking to identify, formulate and solve real world problems of science and engineering.
3. be proficient in arriving at innovative solution to a problem with due considerations to society and environment.
4. be capable of undertaking suitable experiments/research methods while solving the real life problem and would arrive at valid conclusions based on appropriate interpretations of data and experimental results.
5. exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc) relevant to professional practice and demonstrate through actions, the need for sustainable development
6. be committed to professional ethics, responsibilities and economic, environmental, societal and political norms.
7. demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting.
8. develop written and oral communications skills in order to effectively communicate design, analysis and research results.
9. be able to acquire competent positions in industry and academia as well.
10. be able to acquire lifelong learning and continuous professional development.
11. be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time.
12. recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

(B) Programme Specific Outcomes (PSOs)

13. Apply in-depth knowledge gained during the Integrated MSc. Mathematics and Computing program in analyzing and interpreting real life problems for providing the optimal and achievable solutions.

14. Demonstrate combined knowledge of mathematics and computing to manage projects efficiently and economically with intellectual integrity and ethics for sustainable development of society.

15. Capable of using his/her knowledge of mathematical sciences in higher studies of interdisciplinary nature.

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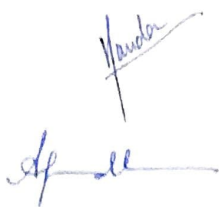
BIRLA INSTITUTE OF TECHNOLOGY- MESRA, RANCHI
REVISED COURSE STRUCTURE
(To be effective from academic session MO-2021)
Based on CBCS system & OBE model Recommended scheme of study
(*For Integrated MSc. in Mathematics and Computing*)

Course Structure Semester-wise:

Semester-I	Semester-II
MA 101 Calculus-I(C-1)	MA 105 Calculus-II (C-4)
MA 102 Real Analysis (C-2)	MA 106 Ordinary Differential Equations (C-5)
MA 109 Matrix Theory (C-3)	MA 110 Complex Analysis (C-6)
CH 111 Chemistry –I (GE-1) CH 112 Chemistry –I Lab (GE-1) Business Communications -I (AECC-1)	PH 109 Physics –I(GE-2) PH 110 Physics –I Lab (GE-2) CE 101 Environmental Science (AECC-2)
MC 101/102/103/104 NCC/NSS/ PT & Games / Creative Arts	CS 101 Programming for problem solving(SEC-1) CS 102 Programming for problem solving Lab (SEC-1)
	MC 105/106/107/108 NCC/NSS/ PT & Games / Creative Arts

Semester-III	Semester-IV
MA 201 Partial Differential Equations (C-7)	MA 311 Numerical Techniques (C-15) MA 319 Computational Lab.(MAT Lab/ Mathematica etc.(SEC-2)
MA 202 Modern Algebra (C-8)	MA 206 Linear Algebra (C-12)
MA 208 Integral Transforms and its Applications (C-9)	CS 204 Object Oriented Programming and Design Pattern (C-13) CS 205 Object Oriented Programming and Design Pattern Lab (C-13)
CS 201 Data Structure (C-10) CS 202 Data Structure Lab (C-10)	CH 213 Chemistry –II (GE-4) CH 214 Chemistry –II Lab (GE-4)
PH 111 Physics –II(GE-3) PH 112 Physics –II Lab (GE-3)	MA209 Integral equations and Greens function/ MA 304 Tensor Analysis/ MA306 Special Functions (DSE-1)
MC 201/202/203/204 NCC/NSS/ PT & Games / Creative Arts	MC 205/206/207/208 NCC/NSS/ PT & Games / Creative Arts

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Semester-V	Semester-VI
MA 301 Probability and Statistics (C-14) MA 302 Probability and Statistics Lab(C-14)	MA 309 Optimization Techniques (C-18) MA 310 Optimization Techniques Lab (C-18)
MA 205 Discrete Mathematics (C-11)	CS 301 Database Management System(C-19) CS 302 Database Management System Lab(C-19)
Business Communication - II (AECC -3)	CS 303 Operating Systems(C-20)
CS 206 Design and Analysis of Algorithm (C-16) CS 207 Design and Analysis of Algorithm Lab (C-16)	
CS 310 Formal Languages & Automata Theory (C-17)	MA307 Computational Linear Algebra/ MA308 Difference equations /CS 321 Soft Computing/ CS 391 Introduction to Distributed System MA317 Wavelet Transform / MA 318 Artificial Network / IT 322 Cloud Computing/CS 325 Database Modelling/ CS 324System programming (DSE-3) (any two)
MA303 Fuzzy Logic /MA305 Graph Theory/ MA 315 Financial Mathematics / MA 313 Combinatorics/ MA 314 Fuzzy Set Theory and its application/ MA 316 Statistics Quality Control and Reliability (DSE-2) (any two)	MA320 Dissertation (Pure Mathematics/ Applied Mathematics/ Computer Science) (DSE-4)

Semester-VII	Semester-VIII
MA 401 Real Analysis and Measure Theory (C-21)	MA412 Topology (C-25)
MA 402Advanced Complex Analysis(C-22)	MA413 Stochastic Process and Simulation (C-26)
CA505 Software Engineering (C-23) CA506 Software EngineeringLab. (C-23)	MA414 Advanced Operation Research (C-27) MA415 Advanced Operation Research Lab. (C-27)
CA603 System Simulation and Modeling (C-24)	CA559 Data Communications and Computer Networks (C-28) CA560 Data Communications and Computer Networks Lab. (C-28)
MA404 Mathematical Epidemiology/MA405 Mathematical Modelling/ MA406 Fuzzy Mathematical Programming/ MA407 Survey Sampling/MA408 Theory of Elasticity/ MA409	MA416 Statistical Inference/ MA418 Mechanics/ MA419 Mathematical Ecology/ MA427 Multiple Criteria Decision Making/CA584 Web Programming/CA640 Machine Learning (DSE-6)

Design of Experiments/ MA410 Differential Geometry/ CA532 Data Mining and Warehousing (DSE-5) (any two)	Open Elective (OE-II)
Open Elective (OE-I)	

Semester-IX	Semester-X
MA501 Functional Analysis(C-29)	MA509 Research Project / Industry Internship (RP-1)
MA502 Number Theory(C-30)	
CA601 Computer Graphics(C-31) CA602 Computer Graphics Lab. (C-31)	
MA503 Statistical Computing/MA504 Finite Element Methods/MA505 Calculus of Variations and Optimal Control/MA506 Advance Difference Equations/ MA507 Computational Fluid Dynamics/ MA508 Qualitative Theory of Differential Equations/ CA630 Cryptography and Network Security/ CA635 Natural Language Processing(DSE-7) (any two)	
MT204 Constitution of India (MC)	

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BIRLA INSTITUTE OF TECHNOLOGY- MESRA, RANCHI
NEWCOURSE STRUCTURE - To be effective from academic session MO-2021
Based on CBCS system & OBE model
Recommended scheme of study
(*For Integrated MSc. in Mathematics and Computing*)

Semester/ Session of Study	Level	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practicals*			Total Credits *C-Credits*
					L *(Periods /week)*	**T** *(Periods /week)*	**P** *(Periods /week)*	**C** *(Credits)*
THEORY								
FIRST Monsoon	1	CC Core Course	MA101	Calculus-I	3	1	0	4
			MA102	Real Analysis	3	1	0	4
			MA109	Matrix Theory	3	1	0	4
		AECC (Ability Enhancement Compulsory Course)		Business Communications - I	0	0	3	1.5
		GE (Generic Elective)	CH111	Chemistry –I	3	1	0	4
LABORATORIES								
	1	GE	CH112	Chemistry –I Lab	0	0	4	2
		MC Mandatory Course	MC 101/102/ 103/104	Choice of: NCC/NSS/PT & Games / Creative Arts (CA)	0	0	2	1
TOTAL								20.5
THEORY								
SECOND Spring	1	CC	MA105	Calculus-II	3	1	0	4
			MA106	Ordinary Differential Equations	3	1	0	4

UG Program (1st - 6th Semester)

			MA110	Complex Analysis	3	1	0	4
		GE	PH109	Physics I	3	1	0	4
		AECC	CE101	Environmental Science	2	0	0	2
		SEC (Skill Enhancement Course)	CS101	Programming for problem solving	3	1	0	4
				LABORATORIES				
	1	**GE**	PH110	Physics I Lab	0	0	4	2
		SEC	CS102	Programming for problem solving Lab	0	0	3	1.5
		MC	MC 105/106/ 107/108	Choice of: NCC/NSS/PT & Games / Creative Arts (CA)	0	0	2	1
				TOTAL				26.5
				GRAND TOTAL FOR FIRST YEAR				47
THIRD Monsoon	**2**	**CC**		**THEORY**				
			MA201	Partial Differential Equations	3	1	0	4
			MA202	Modern Algebra	3	1	0	4
			MA208	Integral Transforms and its Applications	3	1	0	4
			CS201	Data Structure	3	1	0	4
	1	**GE**	PH111	Physics –II	3	1	0	4
				LABORATORIES				
	2	**CC**	CS202	Data Structure Lab	0	0	3	1.5
	1	**GE**	PH112	Physics –II Lab	0	0	4	2
	2	**MC**	MC 201/202/ 203/204	Choice of : NCC/NSS/PT & Games/ Creative Arts CA)	0	0	2	1
				TOTAL				24.5
FOURTH Spring	**2**	**CC**		**THEORY**				
			MA311	Numerical Techniques	3	1	0	4
			MA206	Linear Algebra	3	1	0	4

		CS204	Object Oriented Programming and Design Pattern	3	0	0	3
	GE	CH213	Chemistry II	3	1	0	4
	DSE-1 (Discipline Specific Electives) (Any one from the list)	MA209 /MA30 4/MA3 06	Integral Equations and Green's Function/Tensor Analysis/Special Functions	3	1	0	4
			LABORATORIES				
	CC	CS205	Object Oriented Programming and Design Pattern Lab	0	0	3	1.5
	GE	CH214	Chemistry II Lab	0	0	4	2
2	SEC	MA319	Computational Lab.(MATLAB/ Mathematica etc.	0	0	3	1.5
	MC	MC 205/206/ 207/208	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
			TOTAL				25
			THEORY				
		MA301	Probability and Statistics	3	1	0	4
	3	MA205	Discrete Mathematics	3	1	0	4
FIFTH Monsoon	2	CC	CS 206	Design and Analysis of Algorithm	3	0	0	3
	3		CS 310	Formal Languages & Automata Theory	3	0	0	3
		AECC		Business Communications - II	0	0	3	1.5

	3	DSE-2 (Any two from the list)	MA303/ MA305/ MA315/ MA313/ MA314/ MA316	Fuzzy Logic/Graph Theory/Financial Mathematics Combinatorics/Fuzzy Set Theory and Its Applications/Statistical Quality Control and Reliability	3	1	0	4 X 2 = 8
LABORATORIES								
	3		MA 302	Probability and Statistics Lab	0	0	3	1.5
	2	CC	CS 207	Design and Analysis of Algorithm Lab	0	0	3	1.5
TOTAL								26.5
THEORY								
			MA309	Optimization Techniques	3	1	0	4
		CC	CS 301	Database Management System	3	0	0	3
			CS 303	Operating Systems	3	0	0	3
SIXTH Spring	3	DSE-3 (Any two from the list)	MA307/ MA308/ CS321/ CS391/ MA317/ MA318/ IT322/ CS325/ CS324	Computational Linear Algebra/Difference Equation/Soft Computing/Introduction to Distributed System/ Wavelet Transform/Artificial Neural Network/ Cloud Computing/Database Modelling/ System programming	3	0	0	3 X 2=6
		DSE-4	MA320	Dissertation (Pure Mathematics/ Applied	6	0	0	6

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				Mathematics/ Computer Science)				

				LABORATORIES				
3	CC	MA 310	Optimization Techniques Lab		0	0	3	1.5
		CS 302	Database Management System Lab.		0	0	3	1.5
TOTAL								**25**
Minimum requirement for Degree award of B.Sc. Honours in Mathematics and Computing (1st - 6th Semester)								**148**

PG Program (7th - 10th Semester)

Semester/ Session of Study (Recomm ended)	Level	Category of course	Course Code	Subjects	Mode of delivery & credits L-Lecture; T-Tutorial ;P-Practicals			Total Credits C-Credits
					L (Period s/week)	**T** (Period s/week)	**P** (Period s/week)	**C**
				THEORY				
SEVENTH Monsoon	4	CC	MA 401	Real Analysis and Measure Theory	3	1	0	4
			MA 402	Advanced Complex Analysis	3	1	0	4
	6		CA603	System Simulation and Modeling	3	0	0	3
	5		CA505	Software Engineering	3	1	0	4
	5	DSE-5 (Any two from the list)	MA404 /MA40 5/MA4 06/MA 407/ MA408 /MA40 9/MA4 10/CA5 32	Mathematical Epidemiology/Mat hematical Modelling/Fuzzy Mathematical Programming/Surv ey Sampling/ Theory Of Elasticity/Design of Experiments/Differ	3	0	0	3X2=6

				ential Geometry/Data Mining and Warehousing				
	OE* Open Electives		OE-I	3	0	0	3
LABORATORIES							
5	CC	CA506	Software Engineering Lab	0	0	3	1.5
						TOTAL	25.5

				THEORY				
EIGHTH Spring	4	CC	MA412	Topology	3	1	0	4
			MA413	Stochastic Processes and Simulation	3	0	0	3
			MA414	Advanced Operation Research	3	1	0	4
	4		CA559	Data Communication and Computer Networks	3	1	0	4
	4	DSE-6	MA416 /MA41 8/MA4 19/MA 427CA 584/CA 640	Statistical Inference/Mechanics/Mathematical Ecology/Multiple Criteria Decision Making/Web Programming/Machine Learning	3	0	0	3
		OE*		OE-II	3	0	0	3
LABORATORIES								
	4	CC	MA415	Advanced Operation Research Lab.	0	0	3	1.5
	5	CC	CA560	Data Communication and Computer Networks Lab.	0	0	3	1.5
							TOTAL	24.0

				THEORY				
NINTH Monsoon	5	CC	MA501	Functional	3	1	0	4

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			Analysis				
		MA502	Number Theory	3	1	0	4
6		CA601	Computer Graphics	3	0	0	3
5	DSE-7 (Any two from the list)	MA503/ MA504/ MA505/ MA506/ MA507/ MA508/ CA630/ CA635	Statistical Computing/Finite Element Methods/Calculus of Variations and Optimal Control/Advance Difference Equations/ Computational Fluid Dynamics/Qualitative Theory of Differential Equations/Cryptography and Network Security/ Natural Language Processing	3	0	0	3X2=6

LABORATORIES

6	CC	CA602	Computer Graphics Lab	0	0	3	1.5
2	MC	MT204	Constitution of India	2	0	0	0
						TOTAL	18.5
TENTH Spring	5	RP Research Project / Industry Internship	MA509	Research Project / Industry Internship	0	0	0	12
							Total	12

Total credits of Integrated M.Sc. in Mathematics and Computing (7th - 10th Semester)	80

Minimum requirement for Degree award of Integrated M. Sc. in Mathematics and Computing (1st - 10th Semester)	228

DEPARTMENT OF MATHEMATICS
PROGRAMME ELECTIVES: DSE OFFERED FOR SEMESTER 4-9

DSE / LEVEL		Prerequisites Subjects with code	Code no.	Name of the DSE subjects	L	T	P	C
DSE-1 IV Sem.	3	MA106, MA201	MA209	Integral Equations and Green's Function	3	1	0	4
		MA106, MA201	MA304	Tensor Analysis	3	1	0	4
		MA105	MA306	Special Functions	3	1	0	4
DSE-2 V Sem.	3		MA303	Fuzzy Logic	3	1	0	4
		MA205	MA305	GraphTheory	3	1	0	4
		MA301	MA315	Financial Mathematics	3	1	0	4
		MA205	MA313	Combinatorics	3	1	0	4
		MA303	MA314	Fuzzy Set Theory and its applications	3	1	0	4
		MA301	MA316	Statistical Quality Control and Reliability	3	1	0	4
DSE-3 VI Sem.	3	MA106, MA201	MA307	Computational Linear Algebra	3	0	0	3
		MA106, MA201	MA308	Difference Equations	3	0	0	3
			CS391	Introduction to Distributed System	3	0	0	3
		MA205	CS321	Soft Computing	3	0	0	3
		MA106	MA317	Wavelet Transform	3	0	0	3
		MA102, MA105	MA318	Artificial Neural Network	3	0	0	3
			IT322	Cloud Computing	3	0	0	3
		CS301	CS325	Database Modelling	3	0	0	3
		NIL	CS324	Systems Programming				
DSE-4 VI Sem.	3	---	MA320	Dissertation (Pure Mathematics/ Applied Mathematics/ Computer Science)	6	0	0	6

DSE-5 VII Sem.	4	MA106, MA201	MA404	Mathematical Epidemiology	3	0	0	3
		MA106, MA201	MA405	Mathematical Modelling	3	0	0	3
		MA205	MA406	Fuzzy Mathematical Programming	3	0	0	3
		MA301	MA407	Survey Sampling	3	0	0	3
	4	MA106, MA201	MA408	Theory of Elasticity	3	0	0	3
		MA301, MA407	MA409	Design of Experiments	3	0	0	3
		MA105	MA410	Differential Geometry	3	0	0	3
	5		CA532	Data Mining and Warehousing	3	0	0	3
DES-6 VIII Sem..	4	MA301	MA416	Statistical Inference	3	0	0	3
		MA106, MA201	MA418	Mechanics	3	0	0	3
		MA106, MA201	MA419	Mathematical Ecology	3	0	0	3
		MA309, MA414	MA427	Multiple-Criteria Decision Making	3	0	0	3
	5		CA584	Web Programming	3	0	0	3
	6	CS206	CA640	Machine Learning	3	0	0	3
DSE-7 IX Sem.	5	MA301	MA503	StatisticalComputing	3	0	0	3
		MA106, MA201	MA504	Finite Element Methods	3	0	0	3
		MA106, MA201, MA309	MA505	Calculus of Variations and Optimal Control	3	0	0	3
		MA106, MA201	MA506	Advanced Difference Equations	3	0	0	3
	5	MA106, MA201	MA507	Computational Fluid Dynamics	3	0	0	3
		MA106, MA201	MA508	Qualitative Theory of Differential Equations	3	0	0	3

| | 6 | CA630 | Cryptography & Network Security | 3 | 1 | 0 | 4 |
| | | CA635 | Natural Language Processing | 3 | 0 | 0 | 3 |

BIRLA INSTITUTE OF TECHNOLOGY- MESRA, RANCHI
Revised COURSE STRUCTURE - To be effective from academic session MO-2021
Based on CBCS system & OBE model
Recommended scheme of study

Details of credits distribution for IMSc. in Mathematics and Computing (category wise)

UG Program (1st - 6th Semester)

S.No	Category	Credits
1	CC- Core Courses (Mathematics & Computer Science)	84
2	AECC (Ability Enhancement Compulsory Course	5
3	SEC (Skill Enhancement Course)	7
4	GE (Generic Elective)	24
5	DSE-Discipline Specific Electives (Mathematics & Computer Science)	24
7	MC- Mandatory Course: NCC/NSS/Creative Arts/ PT & Games	4
	TOTAL	148

PG Program (7th -10th Semester)

S.No	Category		Credits
1	CC- Core Courses (Mathematics & Computer Science)		47
2	DSE-Discipline Specific Electives (Mathematics & Computer Science)		15
3	OE-Open Electives		6
4	Research Projects		12
5	MC- Mandatory Course (Constitution of India)		0
	TOTAL		80
Program total Credits for IMSc. in Mathematics and Computing: 148(UG)+80(PG) = 228 Credits			

BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:
Preamble

16.11.2021

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.

CREATING	Putting information together in an innovative way.
EVALUATING	Making judgements based on a set of guidelines.
ANALYSING	Breaking the concept into parts and understand how each part is related to one another.
APPLYING	Use the knowledge gained in new ways.
UNDERSTANDING	Making sense of what you have learnt.
REMEMBERING	Recalling relevant knowledge from long term memory

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