KOLHAN UNIVERSITY

CHAIBASA

UNIVERSITY DEPARTMENT OF MATHEMATICS

Course Content of Mathematics

Under Choice Based Credit System (CBCS)

Syllabus Scheme for CBCS in M. Sc.

Effective from Academic Session 2020-2022.

UNIVERSITY DEPARTMENT OF MAHEMATICS
Kolhan University, Chaibasa

(For CBCS syllabus M. Sc.)

COMPOSITION OF BOARD OF STUDIES

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   Magadh University, Bodh Gaya, Mob. No.-9430239080

3. **Dr. Sanjay Tiwari (External expert)**
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   University Department of Mathematics,
   Magadh University, Bodh Gaya. Mob. No.-6207805152

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Chairman & Head, Department of Mathematics
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10. SEMESTER-WISE DISTRIBUTION OF COURSES

10.1 M. Sc. (Mathematics) Programme:

Table-1: Course Structure for M. Sc. Programme			
Semesters	**Courses**	**Credit**	**Hrs./Week**
I	Core Course-1 (CCMATH101)	4	60
	Core Course-2 (CCMATH102)	4	60
	Core Course-3 (CCMATH103)	4	60
	Core Course-4 (CCMATH104)	4	60
	Core Course-5 (CCMATH105)	4	60
II	Core Course-6 (CCMATH201)	4	60
	Core Course-7 (CCMATH202)	4	60
	Core Course-8 (CCMATH203)	4	60
	Core Course-9 (CCMATH204)	4	60
	Core Course-10 (CCMATH205)	4	60
III	Core Course-11 (CCMATH301)	4	60
	Core Course-12(CCMATH302)	4	60
	Discipline Specific Elective-1 (DSEMATH301)	4	60
	Discipline Specific Elective-1 (DSEMATH302)	4	60
	Project (PR)-1 [PRMATH301]	6	120
IV	Core Course-13 (CCMATH401)	4	60
	Core Course-14 (CCMATH402)	4	60
	Discipline Specific Elective-3 (DSEMATH401)	4	60
	Discipline Specific Elective-4 (DSEMATH402)	4	60
	Project (PR)-2 [PRMATH401]	6	120
Total Credit		**84**	

Project Work:
The credits for the project(s) may vary from 4 (Four) to 12 (Twelve) depending on the prescription for the contents and the number of hours assigned to the same. Normal projects would carry 6(six) credits with 12 hours per week of time involvement.

Marks Weightage of a Course:
Each non-practical/non-project course (CC/DSE) shall be of 100 (Hundred) marks having two components;

1. 70 Marks are assigned to the End Semester University Examination (ESUE).
2. 30 Marks are assigned to Sessional Internal Assesment (SIA) conducted by the Department/College.

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Course Content of Mathematics

Under Choice Based Credit System (CBCS)

Syllabus Scheme for CBCS in M. Sc.

There will be two Semesters in each year. In third & fourth semesters there are **four Elective papers altogether.** Among **DSEMATH301A** & **DSEMATH301B** only one is to be opted; similarly, among **DSEMATH302A** & **DSEMATH302B** only one is to be opted & among **DSEMATH401A** & **DSEMATH401B** only one is to be opted and finally among **DSEMATH402A** & **DSEMATH402B** only one is to be opted.

1st Semester

CCMATH101 100 marks
Real Analysis & Measure Theory

CCMATH102 100 marks
Complex Analysis

CCMATH103 100 marks
Topology

CCMATH104 100 marks
Partial Differential Equation

CCMATH105 100 marks
Integral Equation

2nd Semester

CCMATH201 100 marks
Group Theory

CCMATH202 100 marks
Differential Geometry

CCMATH203 100 marks
Tensor Calculus

CCMATH204 100 marks
Analytical Dynamics

CCMATH205 100 marks
Difference Equation

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3rd Semester

CCMATH301 100 marks
Discrete mathematics.

CCMATH302 100 marks
Functional Analysis.

DSEMATH301A 100 marks
Computer Science
Or
DSEMATH301B 100 marks
Boundary Layer Theory

DSEMATH302A 100 marks
Numerical Methods & Statistics
Or
DSEMATH302B 100 marks
Operations Research

PRMATH301 (Project-1) 100 marks

4th Semester

CCMATH401 100 marks
Ring & Field

CCMATH402 100 marks
Integral Transforms

DSEMATH401A 100 marks
Advanced Real Analysis
Or
DSEMATH401B 100 marks
Calculus of Variations

DSEMATH402A 100 marks
Advanced Set Theory
Or
DSEMATH402B 100 marks
Mathematical Modelling
PRMATH401 (Project-2) 100 marks

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UNIVERSITY DEPARTMENT OF MATHEMATICS
KOLHAN UNIVERSITY, CHAIBASA

Syllabus for M. Sc. Mathematics
CBCS Pattern w. e. f. 2020-22

1st Semester

CCMATH101 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

UNIT I: Real Analysis **Lecture-20** **Question-4**

A1; Sequence and series of function: Uniform convergence of sequence and series of real function. Cauchy's general principle of uniform convergence, continuity of the sum of a series of function. Weiestrass's M-test for uniform convergence. Term by term integration and differentiation.

A2; Fourier series: Fourier series expansion of a function relative to an orthonormal system. Bessel's inequality, pointwise convergence of trigonometric Fourier series, Dirichlet's integral, Perseval's theorem, Riemann-Lebesgue theorem, Problems on finding trigonometric Fourier series representation of periodic functions.

UNIT II: Measure Theory **Lecture-20** **Question-4**

B1: Measure theory: Outer measure, measurable sets through Caratheodory approach, arithmetical properties of measurable sets, two fundamental theorems and examples of uncountable sets of zero measure.

B2: Measurable Functions: Closure of class of measurable function under all algebraic and limit operations, Littlewood's third principle trigonometric Fourier series representation of periodic functions. Function bounded over a set of finite measure, condition of measurability, Lebesgue integral and its arithmetical properties, comparison with R-integral, bounded convergence theorem.

REFERENCE BOOKS:

1. Principle of Mathematical Analysis: Walter Rudin
2. Mathematical Analysis: Shanti Narayan
3. Real Analysis: H. L. Royden
4. Advanced Real Analysis: K. K. Jha
5. Measure theory: Gupta & Gupta

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CCMATH102 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Complex Analysis: **Lecture-40** **Question-8**

A1: Integral: Cauchy's integral theorem, Cauchy's integral formula, Morera's theorem, Liouvillies theorem, Taylor's theorem, Laurent's theorem, Rouche's theorem, fundamental theorem of algebra.

A2: Power series: formula for radius of convergence of power series, absolute & uniform convergence theorem of power series, uniqueness theorem of power series, term by term integration and differentiation theorem.

A3; Residue & poles, contour integration and problems

A4: Conformal mapping: Conformal and bilinear mapping, necessary & sufficient condition for conformal mapping, mapping from half plane to circle, mapping from unit circle to unit circle and related problems.

REFERENCE BOOKS:

1. Complex Variable: Churchill
2. Theory of Functions: Titch Marsh
3. Complex Analysis: J. B. Conway
4. Function of a Complex Variable: Goyal & Gupta

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CCMATH103 **70 Marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Topology **Lecture-40** **Question-8**

A1: Compactness in metric space, Ascoli's theorem.

A2: Topological spaces: Definition, examples, base, sub-base, first axiom space, second axiom space, comparison of topologies.

A3; Compactness: Compact space, Lindeloff space, product space, Tychonoff's theorem, locally compactness.

A4; Separation: T_1 – space, T_2 – space, normal & completely regular space, Uryshon's lemma, Tietze extension theorem, Uryshon's metrization theorem.

A5: Connectedness: connectedness & its properties.

REFERENCE BOOKS:

1. Real Analysis: H. L. Royden, P. M. fitzpatrick
2. Topology: J. N. Sharma, J. P. Chauhan
3. Advanced General Topology: K. K. Jha

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CCMATH104 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Partial Differential Equation **Lecture-40** **Question-8**

A1: Classification of second order partial differential equation, reduction to canonical forms

A2: Fourier transform, sin &cosine transform, inverse Fourier transform, application to ordinary & partial differential equation

A3: Wave equation: Derivation and fundamental solution of one-dimensional wave equation in Cartesian form, Application problem, and one-dimensional solution by separation of variables, D'Alembert's solution of wave equation.

A4: Integral transforms and Green's function method of Solution: Solution of PDE using Separation of variables, Fourier transform and by Laplace transform, Green's function and solution of boundary value problems using Laplace transformations

REFERENCE BOOKS:

1. Partial Differential Equations-L. C. Evans
2. Partial Differential Equations-P. Prasad & R.Ravindran
3. Partial Differential Equations-K. Shankara Rao
4. Advance Engineering Mathematics- E. Kreyszing
5. Use of Integral Transform- I. N. Sneddon

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CCMATH105 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Integral Equation **Lecture-40** **Question-8**

1. Integral equations of first & second kind of Fredholm & Volterra Type
2. Solution by Successive substitutions & successive approximations.
3. Solution of equation with separable kernels.

REFERENCE BOOKS: -

1. Integral Equations by Shanti Swarup.
2. Integral Equations & their Applications by M. Rahman
(WITPress Southampton, BOSTON)

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2nd Semester

CCMATH201 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Group Theory. **Lecture-40** **Question-8**

A1: Isomorphism and homomorphism of groups, isomorphism theorem.
A2: Permutation group & simple group& related topics
A3: Conjugacy classes, normaliser, class equation of a finite group.
A4: Direct products: Direct product of a finite number of groups, necessary & sufficient condition for the isomorphism between the product and the direct product of groups.
A5: Group action orbit stabilizer theorem, Sylow theorem & application in proving non-simplicity for the isomorphism between the product and the direct product of groups

REFERENCE BOOKS:

1. University Algebra: N. S. Gopala Krishna
2. A First Course in Abstract Algebra: J. B. Fraleigh
3. First Course in Group Theory: P. B. Bhattacharya

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CCMATH202 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Differential Geometry **Lecture-40** **Question-8**

A1: Space curve: Curvature and torsion, Serret-Frenet formulae, helix uniqueness theorem for space curve, the circle of curvature, osculating sphere, locus of centre of curvature, spherical curvature, locus of centre of spherical curvature, Bertrand curve.

A2: Curvilinear co-ordinates on a surface, fundamental magnitudes, direction on a surface.

A3: Curve on a surface: Parametric curves, curvature of normal section, Meusier's theorem, principal direction & principal curvature, line of curvature, theorem of Euler and Dupin, conjugate direction and asymptotic line.

A2: Geodesics: Differential equation of geodesics via normal properties, geodesics on developable, curvature & torsion of a geodesics.

REFERENCE BOOKS:

1. Differential Geometry: C. E. Weatherburn
2. Riemannian Geometry: C. E. Weatherburn
3. Differential Geometry: Gupta, Malik & Pundir (Pragati Prakashan, Meerut)

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CCMATH203 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Tensor Calculus **Lecture-40** **Question-8**

A1; Tensor algebra- contravariant and covariant vector (tensor of first order), tensor of second order (or of rank 2), the Kronecker delta, the tensor of higher rank, invariant or scalars, addition and subtraction of tensor, contraction, product of tensor, inner product symmetric tensor, generalised quotient law, conjugate or reciprocal symmetric tensor, relative tensors, group property of tensor, related problems

A2; Covariant differentiation, The Christoffel three index symbols, transformation of Christoffel symbol, covariant differentiation of vector, covariant differentiation to tensor, laws of covariant differentiation of tensor. divergence & curl of a vector, intrinsic derivative, derived vector, cross product of two vectors, Ricci's Theorem, related problems.

REFERENCE BOOKS:

1. Differential Geometry: C.E. Weatherburn.
2. Riemannian Geometry: C.E. Weatherburn.
3. Tensor Calculus----Schaum's series
4. Tensor Calculus and Riemannian Geometry: D. C. Agarwal

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CCMATH204 **80 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Analytical Dynamics **Lecture-40** **Question-8**

A1: Motion in two dimensions: Motion of C. G. and motion about C. G., K. E. slipping of road, motion of sphere on inclined plane when rolling and sliding are combined, motion of circular disk on a plane and related problems.

A2: Moving axes: Velocity and acceleration in two-dimensional motion when the axes are moving, velocity and acceleration in three dimensions when the axes are moving, velocity and acceleration in three-dimensional motion in polar form, angular velocity referred to moving axes and Euler's geometrical equation.

A3: Equation of motion and its application in three dimensions: General equation of motion, Euler's equation of motion, momentum of rigid body, moments about instantaneous axes, K. E. of rigid body and related problems.

A4: Lagrange's equation of motion of small oscillation: Generalized co-ordinates, constraints classification of mechanical systems, Lagrange's equation of motion, principle of energy, small oscillation, normal co-ordinates.

REFERENCE BOOKS:

1. Rigid Dynamics: P. P. Gupta & G. S. Malik.
2. Dynamics Part-II: A. S. Ramsay

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CCMATH205 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Difference Equation **Lecture-40** **Question-8**

A1; Dynamics of first order difference equation, linear first order difference equation, equilibrium points, their stair step (cobweb) diagram, cobweb theorem of economics, criteria for asymptotic stability of equilibrium points, periodic points and cycles, the equation & bifurcation equilibrium-(fixed) points, 2-cycles, 2_2- cycles.

A2: Linear difference equation of higher order: Difference calculus – the power shift factorial polynomials, anti-difference operator, general theory of linear difference equation, linear homogeneous equation with constant coefficients, linear variation of parameters, limiting behaviour of solution, application – propagation of annual plans, gambles ruin national income, the transition of information.

REFERENCE BOOKS:

1. Introduction to Difference Equation: S. N. Elaydi
2. Difference Equation: An Introduction with Application: Kelly & Peterson
3. Difference Equation: D. C. Agarwal
4. Advanced Difference Equations: M. D. Raisinghania

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3rd Semester

CCMATH301 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Discrete mathematics. **Lecture-40** **Question-8**

A1: Partially ordered sets, lattices, geometrical lattices, distributive lattices, modular lattice, complemented lattice.

A2: Logic: Boolean algebra, Boolean expression, application to switching circuits.

A3; Graph theory: Degree sum theorem, Eulerian graph and its properties, Hamiltonian graph, trees, planarity of graphs, Euler's theorem on planar graph and application, chromatic number and five colour theorem, marriage theorem, transversal version of marriage theorem, directed graph, Kruskal's algorithm, Dijkastra's algorithm.

A4; Pigeon hole principle, principle of inclusion & exclusion, derangement.

REFERENCE BOOKSD:

1. Lattice: K. K. Jha
2. Discrete Mathematics: K. D. Joshi
3. Automata Theory-Discrete Mathematics: Tremby & Manohar
4. Graph Theory: R. J. Wilson

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CCMATH302 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Functional Analysis. **Lecture-40** **Question-8**

A1; Cauchy's, Minskowski's and Holder's inequalities, normed linear space, Banach space, definition and examples including classic Banach space, sub-space and Quotient space.

A2; Continuous linear maps, $B(N,N^1)$: Dual (conjugate) space of 'N', natural embedding theorem, dual of R_n and I_p operator and its conjugate Riesz lemma.

A3: Hahn-Banach theorem and consequences, open mapping theorem and projection on Banach space, closed graph theorem and uniform boundedness principle.

A4; Hilbert's Space: Definition and examples, Schwartz inequalities, orthogonal completeness characterization, Gram-Schmidt orthogonalization.

REFERENCE BOOK:

1. Function Analysis: J, N, Sharma & A. R. Vashishtha
2. Elements of Functional Study: Soboreve Lusternic

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DSEMATH301A **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Computer Science **Lecture-40** **Question-8**

Unit-1: FUNDAMENTALS OF INTERNET

The Internet and the World Wide Web: Overview: what is Internet, The Internet's history, The Internet's major services, Understanding the world wide web, Using your browser and the world wide web, navigating the web, closing your browser, getting help with your browser, searching the web, search results and web sites. E-mail and other Internet Services: Overview: communicating through the Internet, Using E-mail, Using an E-mail program, Stomping out spam, using web-based e-mail services, More features of the Internet. Connecting to the Internet: Overview: Joining the Internet phenomenon, Connecting to the Internet through wires, How PC applications access the Internet, Connecting to the Internet wirelessly.

Unit 2:MS WORD

Word Basics : Starting word, Creating a new document, Opening preexisting document, The parts of a word window, Typing text, Selecting text, Deleting text, Undo, Redo, Repeat, Inserting text, Replacing text, Formatting text, Cut , Copy, Paste – Formatting Text and Documents : Auto format, Line spacing, Margins, Borders and Shading. Headers and Footers: Definition of headers and footers, creating basic headers and footers, creating different headers and footers for odd and even pages. Tables: Creating a simple table, Creating a table using the table menu, Entering and editing text in a table, selecting in table, adding rows, changing row heights, Deleting rows, Inserting columns, Deleting columns, changing column width. Graphics: Importing graphics, Clipart, Insert picture, Clip Art Gallery, using word's drawing features, drawing objects, text in drawing. Templates: Template types, using templates, exploring templates, modifying templates. Macros: Macro, Record in macros, editing macros, running a macro. Mail Merge: Mail Merge concept, Main document, data sources, merging data source and main document, Overview of word menu options word basic tool bar.

Unit 3:MS POWER POINT

Basics, Terminology, Getting started, Views: Creating Presentations: Using auto content wizard, Using blank presentation option, Using design template option, Adding slides, Deleting a slide, Importing Images from the outside world, Drawing in power point, Transition and build effects, Deleting a slide, Numbering a slide, Saving presentation, Closing presentation, Printing presentation elements.

REFERENCE BOOK:

1. Peter Norton, Introduction to Computers, sixth Edition, Tata McGraw Hill (2007)
2. Ran Mansfield, working in Microsoft Office, Tata McGraw Hill 2008).

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DSEMATH301B **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Boundary Layer Theory (BLT) **Lecture-40** **Question-8**

A1. Derivation of Navier-Stokes equation of motion for a viscous flow, Poiseuille flow through a pipe, plane Couette flow, stagnation point, flow between two concentric rotating cylinders, flow near rotating disk, slow motion, limiting case of large small viscosity, linearization of the Navier-Stokes equations by method of Stokes and Oseen.

A2. Boundary layer concept, boundary layer thickness, displacement thickness, derivation of boundary layer equation for flow along a plane and curved wall, Reynold's principle of similarity, similar solutions, boundary layer along a flat plate, a wedge, a circular cylinder and in a convergent channel. A xi-symmetric boundary layer on a body of revolution, boundary layer growth for impulsive start of motion & for uniformly accelerated motion.

A3. The momentum equation for the boundary layer and its application to the flow past a flat place at zero incidence.

REFERENCE BOOK:

1. Boundary Layer Theory: H. Schlichting
2. Modern Development in Fluid Dynamics. Vol-I & II: S. Goldstain
3. Viscous Fluid Dynamics by J L Bansal.

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DSEMATH302A **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Numerical Methods & Statistics **Lecture-40** **Question-8**

1. Bisection method, False-Position method, Newton-Raphson method for roots of non-linear equations, Basics Gauss Elimination method, Triangular factorization method for direct solution of system of linear equations, Linear interpolation, Lagrange's & Newton's Interpolation, Spline Interpolation.
2. Statistical Techniques: Probability distribution, Binomial distribution, Poisson's distribution & Normal distribution. Regression analysis: Lines of regression, properties of Coefficient of regression.

REFERENCE BOOK:

1. Introductory probability & Statistical applications by P.L.Mayer.
2. Numerical Analysis: Lalji Prasad
3. Numerical Analysis: Dutta & Jana
4. Numerical Analysis: Bhupendra Singh

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DSEMATH302B **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Operations Research **Lecture-40** **Question-8**

A1: Inventory; Known demand, probabilistic demand, deterministic model and probabilistic model without lead time.

A2: Project planning and control with PERT-CPM: Rules of network construction, time calculation in networks, critical path method, PERT, PERT calculations, advantages of network (PERT/CPM), difference between CP and PERT

A3: Game theory: Two-person, zero-sum games, games with mixed strategies, graphical solution, solution by linear programming.

A4: Integer programming: Branch and bound technique, Gomory's cutting plane method.

REFERENCE BOOKS:

1. Operation Research: R. K. Gupta.
2. Introduction to Operation Research: F. S. Hillier & G. L. Lieberman.
3. Operation Research: A. M. Natrajan, P. Balaguruswami, A. Tamilarasi.
4. Operation Research: Kanti Swaroop, P. K. Gupta & Man Mohan.
5. Operation Research: S. D. Sharma.
6. Operation Research: Prem Kumar Gupta & D. S. Hira

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PRMATH301

Project courses will be of 100 marks and there shall be no internal written examinations. The total hundred marks will have the following three components:

1. Periodical representation **– 20 marks**.
2. The written component of the project i.e. project report **– 60 marks.**

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3. Viva voce examination jointly conducted by an external examiner by the university & the internal supervisor/guide **– 20 marks.**

Project Work of 100 marks should be related to any topic of the syllabus of 3rd semester. The project work, related to different branches of Mathematics included in semester-III, must be submitted in the form of spiral/hard bound dissertation, typed on one side of the paper containing at least 80 (Eighty) pages and not more than 100 (Hundred) pages.

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4th Semester

CCMATH401 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Ring & Field **Lecture-40** **Question-8**

A1: Factorization in integral domain: Concept of divisibility in integral domain, GCD & LCM of two non-zero elements in an integral domain, irreducible and prime elements in an integral domain, relation between prime and irreducible elements, definition and examples of Euclidean domain, principal ideal domain and unique factorization domain, relation between Euclidean domain, principal ideal domain and unique factorization domain, the integral domain Z[I] and K[X] K field properties of Euclidean domain, principal ideal domain and unique

A2: factorization domain, Einstein criteria of irreducibility, Gauss's lemma.

Field theory: Extension of a field, finite extension and infinite extension, algebraic extension and transcendental extension, properties of algebraic extension, relation between algebraic and finite extension, splitting field of a polynomial over a field, normal extension, characterization of finite normal extension, separable extension and properties of a separable extension, perfect field and characterization of perfect field, primitive element theorem, finite field and their existence.

REFERENCE BOOKS:

1. University Algebra: N. S. Gopalakrishna
2. Advanced Course in Modern Algebra: Goyal & Gupta
3. Modern Algebra: M. L. Khanna

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CCMATH402 **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Integral Transforms **Lecture-40** **Question-8**

A1. The Stieltjes integrals: Existence of Stieltjes integrals, properties of Stieltjes integrals, the Stieltjes integral as a series or a Lebesgue integral, normalization, improper Stieltjes integral. laws of the mean, change of variable of indefinite integral, Stieltjes integral as infinite series-second method.

A2. The Laplace- Stieltjes transform: Region of convergence, abscissa of convergence, absolute convergence, uniform convergence.

A3. Abelian theorem for the Laplace and Stieltjes transform, Tauberian theorems, Tauberian theorems for the Stieltjes transform.

A4. Inversion and representation problems for the Laplace transform, Laplace asymptotic of an integral, application to integrals leading to direct inversion formula, general representation theorem.

REFERENCE BOOKS:

1. The Laplace Transform: D. V. Widder
2. The Fourier Transform: I. N. Sneddon

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DSEMATH401A **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Advanced Real Analysis: **Lecture-40** **Question-8**

R^n-space and function of several variables:

1. n-dimensional Euclidean space, open and closed sets, compact sets, triangular inequality, limit point of a set, Bolzano Weierstrass theorem, Heine-Borel theorem, concept of limit and continuity of a real valued function of several variables and related theorems. Uniform continuity, intermediate value theorem, partial derivatives, directional derivatives and mean value theorem.
2. Partial derivative of higher order, Schwartz theorem, Young's theorem and Taylor's theorem.
3. Jacobian of transformation and implicit function theorem.

REFERENCE BOOK:

1. Advanced Real Analysis by Dr. K. K. Jha (Navbharat Prakashan)
2. Mathematical Analysis by Shanti Nrayan (S Chand & Co.)
3. Real Analysis by H. L. Royden

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DSEMATH401B **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Calculus of Variations: **Lecture-40** **Question-8**

1. Variational Problems with fixed boundaries: Introduction, Variation & its properties, proximity of curves, Linear Functional, Variational problems, Calculus of variation.
2. Fundamental lemma of calculus of variations, Euler's equation (Euler-Lagrange's equation) with related problems, Brachistochrone problem.
3. External of the function, Necessary and sufficient condition for extrema variational methods for boundary value problems in ordinary 7 partial differential equations.

REFERENCE BOOKS:

1. Advanced ODE and PDE by M. D. Raisinghania
2. Calculus of Variations with Applications by A. S. Gupta

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DSEMATH402A **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Advanced Set Theory: **Lecture-40** **Question-8**

1. Countability & Cardinality with related theorems, Continuum hypothesis, Cantors theorems Cardinals arithmetic (sum, product & power of cardinal numbers), cardinality of power set of a sets, related problems
2. Partial & total order relation: Partially & totally ordered sets, Lattices, Maximal & minimal elements in a POSET, Zorn's lemma
3. Generalised De-Morgan's laws and related concepts.

REFERENCE BOOKS:

1. Advanced set theory by K. K. Jha
2. Set theory by Lalji Prasad

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DSEMATH402B **70 marks**

A total of **EIGHT** questions will be set in which Question No. 1(One) will be Objective Type Question (MCQ/True-False/Fill in the Blanks etc.) consisting 10(Ten) questions of 1(One) mark each and will be COMPULSORY. Any **FOUR** questions shall have to be answered by the examinee out of the remaining **SEVEN** questions carrying 15(Fifteen) marks each.

Mathematical Modelling: **Lecture-40** **Question-8**

1. Introduction, Scope of the study, Basic steps of Mathematical Modelling, Its need, Types of Models, Limitations.
2. Mathematical Modelling in the Biological environment: Single species population models, Single logistic models, formulation, solution, interpretation and simultaneous Stochastic Models of population growth.
3. Two species population model: A simple prey predator model, formulation, solution, interpretation and limitations.
4. Mathematical modeling of epidemics: Basic concepts, a simple deterministic model (Simple epidemic model) formulation, solution, interpretation and limitations.
5. General epidemic model, formulation, solution, interpretation and limitations. Control of an epidemic.

REFERENCE BOOKS:

1. Mathematical Modelling by J. N. Kapoor
2. Concept of Mathematical Modelling by W. Meyer (Academic Press, New-York)
3. Mathematics for Dynamic Modelling by E. Beltarmi (Academic Press, Florida)

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PRMATH402:

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1. Periodical representation **– 20 marks**.
2. The written component of the project i.e. project report **– 60 marks.**

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3. Viva voce examination jointly conducted by an external examiner by the university & the internal supervisor/guide **– 20 marks.**

Project Work of 100 marks should be related to any topic of the syllabus of 4th semester. The project work, related to different branches of Mathematics included in semester-IV, must be submitted in the form of spiral/hard bound dissertation, typed on one side of the paper containing at least 80 (Eighty) pages and not more than 100 (Hundred) pages.

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Sessional Internal Assessment (SIA) – 30 Marks

The SIA for 30 (Thirty) marks will be conducted by the Department/College for every CC paper & DSE paper. The marks of SIA further break into the following manners.

1. Internal written examination (Subjective/Objective Type)- - 20 Marks
2. Written Assignment - - - - - - 05 Marks
3. Overall performance of student including regularity in class-room lectures/seminars and other activities of the Department/College - - - 05 Marks

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