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॥ अंतरी पेटवू ज्ञानज्योत ॥

NORTH MAHARASHTRA UNIVERSITY, JALGAON.

Syllabus for F.Y.B.Sc.

MATHEMATICS.

(W.e.f. Acd.Yr. 2002 - 2003)

North Maharashtra University, Jalgaon.

Syllabus For - F.Y. B.Sc.

Mathematics
With Effect from Acd. Yr. 2002-2003

Paper I	:	Calculus	Code No. :
Paper II	:	Matrices and Differential Equations.	Code No. :
Paper III (A)	:	Geometry and Algebra	Code No. :
		OR	
Paper III (B)	:	Graph Theory and Algebra	Code No. :

North Maharashtra University, Jalgaon

F.Y.B.Sc. Mathematics

Syllabus with limitations and scope (with effect from Acd.Yr. 2002-2003)

PAPER I : CALCULUS

1. Sequences. **(8 Period) (10 Marks)**

Intervals. Bounded and unbounded sets of real numbers. Least upper bound and greatest lower bound. Convergence of a sequence [to a limit] Motivation of $\in$ - N definition. Algebra of limits of a sequence (statements only). Monotonic sequences. Convergence of monotonic sequences. Convergence of the sequence $\left\{ (1+\frac{1}{n})^n \right\}$, The number 'e'. Convergence of a geometric sequence.

2. Series **(8 Period) (10 Marks)**

Convergence of series of non-negative terms. Cauchy's general principle of convergence. Comparison test. Convergence of the series $\sum \frac{1}{n^p}$, $p \in R$. D' Alembert's ratio test. (without proof Cauchy's root test. (without proof).

3. Indeterminate forms. **(8 Period) (7 Marks)**

L' Hospital's Rules. (without proofs)

4. Continuity of functions. **(6 Period) (8 Marks)**

Continuity of a function of real numbers.

Properties of a continuous function on closed and bounded intervals.

(i) Boundedness.

(ii) Attains its bounds.

(iii) Intermediate value theorem.

Uniform Continuity.

5. Mean Value Theorems. **(10 Period) (10 Marks)**

Differentiability of a function. Continuity and differentiability. Rolle's Theorem.

Lagrange's Mean Value Theorem. Cauchy's Mean Value Theorem.

6. Successive Differentiation. **(8 Period) (10 Marks)**

The n^{th} derivatives of some standard of functions. Leibnitz's theorem.

7. Taylor's Theorem, Maclaurin's Therorem. **(6 Period) (10 Marks)**

8. Integration. **(6 Period) (10 Marks)**

Integration by partial fractions.

Denominator involving i) Linear non-repeated. ii) Linear repeated

iii) Quadratic non-repeated factors only

9. Integration of irrational algebraic functions of the form. **(9 Period) (10 Marks)**

i) $\int \sqrt{(ax^2+bx+c)}\,dx$

ii) $\int (px+q)\sqrt{ax^2+bx+c}\,dx$

iii) $\int \frac{dx}{(px+q)\sqrt{ax+b}}$

iv) $\int \frac{dx}{(px^2+qx+r)\sqrt{ax+b}}$

v) $\int \frac{dx}{(px+q)\sqrt{ax^2+bx+c}}$ vi) $\int \frac{dx}{(px^2+qx+r)\sqrt{ax^2+bx+c}}$

Integration of some rational functions by substitution.

i) $\int \frac{x^2 \pm 1}{x^4+1} dx$, ii) $\int \frac{x^2+1}{x^4 \pm kx^2+1} dx$

10. Reduction Formulae. **(8 Period) (10 Marks)**

Reduction formulae for : $\int_0^{\pi/2} \sin^n x\, dx$ $\int_0^{\pi/2} \cos^n x\, dx$ (without proof)

$\int \sin^m x \cos^n x\, dx$, $\int_0^{\pi/2} \sin^m x \cos^n x\, dx$, $\int \frac{\sin nx}{\sin x} dx$

11. Application of Integration. **(8 Period) (10 Marks)**

Rectification Area Volume Surface Area (Theory is not expected)

PAPER - II : MATRICES AND DIFFERENTIAL EQUATIONS

1. Adjoint and Inverse of a matrix. **(12 Periods) (15 Marks)**

Transpose of a matrix. Symmetric and skew symmetric matrices. Adjoint of a matrix. Inverse of a matrix. Existence and uniqueness of inverse of a matrix Properties of inverse.

2. Rank of a Matrix **(12 Periods) (15 Marks)**

Elementary transformations Equivalent matrices, Elementary matrices. Rank of a matrix Invariance of rank under elementary transformations. Reduction of a matrix to its normal form, Non-singular matrix as a product of E-matrices. Rank of product of two matrices.

3. System of linear equations. **(10 Periods) (10 Marks)**

Consistency and solution of homogeneous and non-homogeneous linear equations.

4. Eigen Values and Eigen vectors **(10 Periods) (10 Marks)**

Eigen values and eigen vectors of a square matrix. Characteristic equation of a matrix Cayley-Hamilton Theorem (statement only) and verification. Inverse of a matrix by using Cayley - Hamilton Theorem.

5. Differential Equation of first order and first degree. **(20 Periods) (20 Marks)**

Homogeneous equation. Non-homogeneous equation. Exact equation. Integrating factor. Linear differential equation. Bernoulli's differential equation.

6. Differential Equation of first order and higher degree. **(10 Periods) (15 Marks)**

Solvable for p,y,x. Clairaut's equation

7. Application of Differential Equations **(12 Periods) (15 Marks)**

Orthogonal trajectories, Singular Solutions Envelopes.

PAPER - III (A) : GEOMETRY AND ALGEBRA

1. Co-ordinates is space. **(8 Periods) ([illegible] Marks)**

Co-ordinates of a point in space. Change of origin, Distance formula. Section formula. Direction cosines and direction ratios of a line, Angle between two lines, Projection of a line segment.

2. Plane **(12 Periods) (15 Marks)**

Equations of a plane. Angle between two planes. Distance of a point from the plane: Distance between two parallel planes; system of planes.

3. Line **(12 Periods) (15 Marks)**

Equations of a line, Distance of a point from a line, Angle between line and plane, Coplaner lines, Skew lines.

4. Sphere **(12 Periods) (15 Marks)**

Equations of a sphere, Tangent plane and condition of tangency, Section of a sphere by a plane, Interpretation of the equations $S+\lambda S'=0$ and $S+\lambda U=0$; Relative positions of two sphere; Condition of orthogonality.

5 Divisibility of integers. **(12 Periods) (15 Marks)**

Natural numbers, Peano's axioms, Well ordering principle. (statement only). Principle of mathematical induction.

Divisibility of integers and theorems

Division algorithm (without proof)

G.C.D. and L.C.M. Euclidean algorithm (without proof) Unique factorisation theorem (without proof)

6. Congruence classes **(10 Periods) (10 Marks)**

Partition of a set.

(i) Equivalence relation. Equivalence classes theorem.

(ii) Congruence relation (modulo n) and theorems

(iii) Properties of residue classes

Composition tables

Fermat's theorem

7. Complex numbers **(10 Periods) (10 Marks)**

Algebra of complex numbers

Geometric - representation of complex numbers.

Modulus - Amplitude form of a complex number (Polar form)

Triangular Inequalities

8. De - Moivre's Theorem. **(10 Periods) (15 Marks)**

De-Moivre's theorem for rational indices.

n-n^{th} roots of unity and their geometrical interpretation.

n^{th} roots of a complex number.

PAPER III (B) : GRAPH THEORY AND ALGEBRA

1. **Graphs :** (10 Periods) (10 Marks)
   Definition, Simple Graph, Handshaking Lemma, Isomorphism of Graphs, Types of graphs Operations on graphs.

2. **Connected Graphs :** (8 Periods) (10 Marks)
   Walk, trail, path, cycles (circuits), Connected & disconnected graph, Cutvertices and connectivity

3. **Trees :** (8 Periods) (10 Marks)
   Definition and properties of trees, Distance & Centres in a tree, Rooted and Binary trees. Spanning trees, Kruskel's algorithm for shortest spanning trees, weighted graph.

4. **Eulerian and Hamiltonian Graph :** (6 Periods) (5 Marks)
   Konigsberge seven bridge problem. Eulerian trail. Eulerian graph, Hamiltonian path. Hamiltonian cycle. Hamiltonian graph, Travelling salesman problem

5. **Planar and Dual Graphs :** (5 Periods) (5 Marks)
   Planar graph, Plane Graph, Euler's theorem for planar graph. Kuratowski's two graphs, Geometrical dual Coloring of a graph

6. **Matrix Representation of a Graph :** (5 Periods) (5 Marks)
   The Adjacency matrix and Incidence matrix properties

7. **Directed graph (Digraph)** (3 Periods) (5 Marks)
   Definition, Indegree, Outdegree of a vertex, The Adjacency and Incidence Matrix of a digraph Types of digraph.

8. **Divisibility of integers.** (12 Periods) (15 Marks)
   Natural numbers. Peano's axioms, Well ordering principle. (statement only). Principle of mathematical induction. Divisibility of integers and theorems
   Division algorithm (without proof)
   G.C.D. and L.C.M. Eucledean algorithm (with out proof) Unique factorisation theorem (without proof)

9. **Congruence classes** (8 Periods) (10 Marks)
   Partition of a set. (i) Equivalence relation, Equivalence classes theorem.
   (ii) Congruence relation modulo m) and theorems (iii) Properties of residue classes
   Composition tables Fermat's theorem

10. **Complex numbers** (10 Periods) (10 Marks)
    Algebra of complex numbers
    Geometric representation of complex numbers.
    Modulus - Amplitude form of a complex number (Polar form)
    Triangular Inequalities

11. **De - Moivre's Theorem.** (10 Periods) (15 Marks)
    De-Moivre's theorem for rational indices.
    n-n^{th} roots of unity and their geometrical interpretation.
    n^{th} roots of a complex number.

IMP Note - The weightage of marks will change according to the pattern of the question paper with slight variations.

North Maharashtra University, Jalgaon

F.Y.B.Sc. Mathematics

Syllabus with limitations and scope (with effect from Acd.Yr. 2002-2003)

PAPER I : CALCULUS

1.00 Sequences. **(8 Period) (10 Marks)**

1.01 Bounded and unbounded sets.
Definations - Upper bound, Lower bound
. Bounded sets.

1.02 Least Upper Bound, Greatest Lower Bound
Definitions and examples.

1.03 Sequences - Definition, Limit of a sequence.
Theorems on limit of a sequence.
(without proof)

1.04 Convergence of sequences - Definitions.

1.05 Properties of convergent sequences.

1.06 Geometric sequences.

1.07 Monotonic sequences.

1.08 Bounded sequences.

1.09 Supremum and infimum of a sequence.

1.10 Monotonic bounded sequences

1.11 The number e. Prove that the sequence

$\left\{\left(1+\frac{1}{n}\right)^n\right\}$ is convergent and it converges to the number e, where $2 < e < 3$.

2.00 Infinite Series. **(8 Period) (10 Marks)**

2.01 Convergence of Series - Definitions.

2.02 Geometric series - Prove that the geometric series $\sum_{n=1}^{\infty} r^{n-1}$ is
i) convergent if $|r| < 1$ and ii) non - convergent if $|r| \geq 1$

2.03 Theorems on convergence of series.
(without proof) Comparison Test (without proof)

2.04 Hyper hormonic series or p-series.
Prove that the series

$$\sum \frac{1}{n^p} = \frac{1}{1^p} + \frac{1}{2^p} + \frac{1}{3^p} + \frac{1}{4^p} + \frac{1}{5^p} + \cdots + \frac{1}{n^p} + \cdots$$

converges if $p > 1$ and diverges if $p \leq 1$

2.05 D' Alembert's Ratio Test (without proof)

2.06 Cauchy's root test (without proof)

3.00 Indeterminate Forms. **(8 Period) (7 Marks)**

3.01 L' Hospital's rules (statement only) -

3.02 Examples on the forms

$\frac{0}{0}$, $\frac{\infty}{\infty}$, $\infty - \infty$, $0 \times \infty$, 0^0, ∞^0 and 1^{∞}.

4.00 Continuity **(6 Period) (8 Marks)**

4.01 Definition of a limit of f(x) as x tends to a.

4.02 Oscillatory function - Definition.

4.03 One-sided limit - Right hand limit - Left hand limit.

4.04 Definition of a limit of f(x) as x tends to ∞.

4.05 Theorems on algebra of limits (without proof)

4.06 Continuity of a function at a point

Definition - ϵ-δ definition

4.07 Continuity of a function on an interval.

4.08 Discontinuity and its various types. Removable and irremovable discontinuities.

4.09 Properties of functions continuous at a point (without proof)

4.10 Properties of functions continuous over a closed interval.

(i) Every continuous function on closed and bounded interval is bounded.

(ii) Every continuous function on closed and bounded interval attains its bounds.

(iii) If f(x) is continuous on [a,b] and f(a) f(b) have opposite signs, then f(x) = 0 for some $x \in (a,b)$ (without proof)

(iv) (Intermediate value theorem). Let f be a continuous function on [a,b], then f assumes every value between f(a) and f(b)

4.11 Uniform continuity - Definition.

5.00 Mean Value Theorems. (10Period)(10 Marks)

5.01 Differentiability and derivability of a function.

Definitions - Derivative. Right hand and left hand derivative.

5.02 If a function f is derivable at x, then f is continuous at x. Converse.

5.03 Rolle's Theorm Geometrical Interpretation.

5.04 Lagrange's Mean Value Theorem.

Geometrical Interpretation.

5.05 Cauchy's Mean Value Theorem.

6.00 Successive Differentiation. (8 Period) (10 Marks)

6.01 Successive Derivatives.

6.02 The n^{th} derivaties of some standard functions - $e^{(ax+b)}$, $(ax+b)^m$, x^m, $1/(ax+b)$ $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$.

6.03 Leibnitz's Theorem.

7.00 Taylor's and Maclaurin's Theormes. (6 Period) (10 Marks)

7.01 Taylor's theorem with Lagrange's form of remainder.

7.02 Maclaurin's theorem with Lagrange's form of remainder.

7.03 Taylor's theorem with Cauchy's form of ramender.

7.04 Maclaurin's theorem with Cauchy's form of remainder.

7.05 Power series expansions of some elementary functions.

e^x, sinx, cosx, $(1+x)^n$, log(1+x) if $x < 1$

7.06 Examples.

8.00 Integration (Definite and Indefinite) (15Period)(20 Marks)

8.01 Method of partial fractions.

(i) Denominator containing non-repeated linear factors only.

(ii) Denominator containing repated linear factors.

(iii) Denominator containing one linear and one irreducible quadratic factor only.

8.02 Integration of irrational algebraic function of the form

i) $\int \sqrt{ax^2 + bx + c}\, dx$ ii) $\int (px + q) \sqrt{ax^2 + bx + c}\, dx$

iii) $\int \frac{dx}{(px + q)\sqrt{ax + b}}$ iv) $\int \frac{dx}{(px^2 + qx + r)\sqrt{ax + b}}$

iv) $\int \frac{dx}{(px + q)\sqrt{ax^2 + bx + c}}$ v) $\int \frac{dx}{(px^2 + qx + r)\sqrt{ax^2 + bx + c}}$

8.03 Integration of some rational functions by substitution.

i) $\int \frac{x^2 \pm 1}{x^4 + 1}\, dx$ ii) $\int \frac{x^2 \pm 1}{x^4 \pm kx^2 + 1}\, dx$

9.00 Reduction formulae. (8 Period) (10 Marks)

9.01 Reduction formula for $\int_0^{\pi/2} \sin^n x\, dx$, $\int_0^{\pi/2} \cos^n x\, dx$ (without proof)

9.02 Reduction formula for

i) $\int \sin^m x \cos^n x\, dx$, ii) $\int_0^{\pi/2} \sin^m x \cos^n x\, dx$,

9.03 Reduction formula for $\int \frac{\sin nx}{\sin x}\, dx, n > 1$

10.00 Applications of Integration. (8 Period) (10 Marks)

(Theory is not expected)

10.01 Rectification.

10.02 Area.

10.03 Volume.

10.04 Surface area.

PAPER - II : MATRICES AND DIFFERENTIAL EQUATIONS

1.00 Adjoint and Inverse of a matrix. (12 Periods) (15 Marks)

1.01 Definitions of transpose of a matrix, symmetric and skew symmetric matrices.

1.02 Definitions of minor and cofactor of an element of a matrix.

1.03 Determinant of a matrix, singular and non singular matrices.

1.04 Related properties of determinant of a matrix.

1.05 Adjoint of matrix.

1.06 Theorems : 1) $A(\text{adj}A) = (\text{adj}A)A = |A| I$ 2) $(\text{adj}A)' = (\text{adj}A')$

3) $\text{adj}(AB) = (\text{adj}B)(\text{adj}A)$ 4) $|\text{adj}A| = |A|^{n-1}$

5) $\text{adj}(\text{adj}A) = |A|^{n-2} A$ 6) $\text{adj}(kA) = k^{n-1}(\text{adj}A)$

1.07 Definition of Inverse of a matrix.

1.08 Necessary and sufficient condition for existence of inverse of a matrix (with proof)

1.09 Uniqueness of inverse of a matrix (with proof)

1.10 Computation of inverse by using the adjoint of a matrix.

1.11 Properties of inverse of a matrix.

1) $(AB)^{-1} = B^{-1} A^{-1}$ 2) $(A^n)^{-1} = (A^{-1})^n$ 3) $(A^{-1})' = (A')^{-1}$

4) $(kA)^{-1} = \frac{1}{k} A^{-1}$

5) $|A^{-1}| = \frac{1}{|A|}$

2.00 Rank of a matrix. (12 Periods) (15 Marks)

2.01 Elementary Transformations, Equivalent matrices, Elementary matrices.

2.02 Theorem (only statement and illustration)

$\sigma(AB) = (\sigma A)B$; σ is ERT

$\sigma(AB) = A(\sigma B)$; σ is ECT

2.03 Theorem (with proof)

$\sigma A = EA$ σ is ERT

$\sigma A = AE$ σ is ECT

2.04 Theorem (with proof)

The inverse of an elementary matrix is an elementary matrix of the same type.

2.05 Definitions of submatrix, minor of a matrix, Rank of a matrix.

2.06 Theorem (with proof) Invariance of rank under elementary transformations.

2.07 Definition of Normal form

2.08 Theorems (with proof)

1) Reduction of a matrix to Normal form

2) Existence of non-singular matrices P & Q such that $PAQ = \begin{bmatrix} I_r & 0 \\ 0 & 0 \end{bmatrix}$

3) Non-singular matrix as a product of Elementary matrices

4) $PA = \begin{bmatrix} G \\ O \end{bmatrix}$ $AQ = [H \quad O]$

2.09 Rank of the Product Theorem (with proof)

$\rho(AB) \leq \min\{\rho(A), \rho(B)\}$

3.00 System of Linear Equations. (10 Periods) (10 Marks)

3.01 Definition and representation of homogeneous and non-homogeneous systems of linear equations i.e. $AX = O$, $AX = B$.

3.02 Theorem (only statement)

A system $AX = B$ is consistent iff $\rho(A) = \rho(A, B)$

3.03 Working rule for solving $AX = O$, $AX = B$

4.00 Eigen values and Eigen Vectors (10 Periods) (10 Marks)

4.01 Definitions and illustrations of Eigen values and Eigen vectors.

Consider only 2 x 2 matrices to find eigen vectors.

4.02 Definition and examples on characteristic equation of a matrix.

4.03 Cayley - Hamilton Theorem (statement only)

4.04 Verification of Cayley - Hamilton Theorem.

4.05 Inverse of a matrix by using Cayley - Hamilton Theorem. Examples.

5.00 Differential Equation of first order and first degree. **(20 Periods) (2) Marks)**

5.01 Homogeneous Differential Equation Definition and method of solving it.

5.02 Non-homogeneous Differential Equation

5.03 Exact Equation : Definition.

5.04 Necessary and sufficient condition (with proof) for the equation Mdx + Ndy = 0 to be exact.

5.05 Definition of integrating factor.

5.06 Rules for finding IF (with proof) for the equation Mdx + Ndy = 0 if

i) the equation is homogeneous

ii) the equation is of the type $y f_1(xy)dx + x f_2(xy)dy = 0$

iii) $\dfrac{\dfrac{\delta M}{\delta y} - \dfrac{\delta N}{\delta x}}{N}$ is a function of x alone

iv) $\dfrac{\dfrac{\delta N}{\delta x} - \dfrac{\delta M}{\delta y}}{M}$ is a function of y alone

IF by inspection is not expected.

5.07 Linear Differential Equation

Definition and method of solving the linear differential equation $\dfrac{dy}{dx} + Py = Q$.

Where P & Q are functions of x alone. Also examples on these equation of the type $\dfrac{dx}{dy} + Px = Q$. and examples reducible to linear differential equaction by substitution should be taken.

5.08 Bernoulli's equation

Method of solving Bernoulli's equation

$\dfrac{dy}{dx} + Py = Qy^n$, n = 1

Also examples on the equations of the type be $\dfrac{dx}{dy} + Px = Qx^n$ be taken.

6.00 Differential Equation of first order and higher degree f(x,y,p) = 0

(10 Periods) (15 Marks)

6.01 Solvable for p

6.02 Solvable for y

6.03 Solvable for x

6.04 Clairaut's equation and method of solving it.

6.05 Equation reducible to Clairaut's equation by proper substitutions (substitutions be given)

7.00 Application of Differential Equations **(12 Periods) (15 Marks)**

7.01 Orthogonal trajectories

7.02 Differential equation of family of curves.

7.03 To find the orthogonal trajectories of a family of curves when its equation is in the cartesian form . The following families of curves be taken

i) Family of standard circles ii) Family of general circles iii) Family of parabolas iv) Family of conics v) Family of curves such as

$xy = c^2$, $x^{2/3} + y^{2/3} = a^{2/3}$, $(y)^2 = x^3$

7.04 Singular Solution

i) p - discriminant relation of $f(x,y,p) = 0$

ii) c - discriminant relation of $\phi(x,y,p) = 0$

iii) Definition of singular solution of simple differential equations

7.05 Envelope of family of curves simple examples are expected.

PAPER III (A) : GEOMETRY AND ALGEBRA

1.00 Co-ordinates in space **(8 Periods) (5 Marks)**

1.01 Coordinates of a point in space

1.02 Change of origin

1.03 Distance Formula

1.04 Section formula and corollaries for

i) Mid Point ii) Centroid of triangle iii) Centroid of tetrahedron

1.05 Direction cosines and direction ratios of a line; Identities.

1.06 Angle between two lines.

1.07 Projection of a line segment.

2.00 Plane **(12 Periods) (15 Marks)**

2.01 General Equation of a plane.

2.02 Equations of coordinate planes and planes parallel to coordinate planes.

2.03 Intercept form.

2.04 Normal Form

2.05 Point-direction ratio form.

2.06 Plane passing through three points.

2.07 Reduction of general equation to the -

i) Normal form ii) Intercept form

2.08 Angle between two planes

2.09 Distance of a point from the plane.

2.10 Distance between two parallel planes

2.11 System of planes ($u + \lambda v = 0$).

3.00 Line **(12 Periods) (15 Marks)**

3.01 Line as a intersection of two planes

3.02 Symmetric equations of a line.

3.03 Equations of a line through two points.

3.04 Transformation from unsymmetric to symmetric form.

3.05 Positions of line and plane.

3.06 Angle between a line and plane.

3.07 Distance of a point from the line.

3.08 Coplaner lines.

3.09 To find the point of intersection of two lines.

3.10 Length and equations of the shortest distance between skew lines.

4.00 Sphere **(12 Periods) (15 Marks)**

4.01 Standard equation of sphere.

4.02 Centre-Radius form.

4.03 Diameter form.

4.04 Sphere passing through four points

4.05 Intersection of a line and sphere.

4.06 Tangent line and tangent plane to the sphere.

4.07 Condition of tangency.

4.08 Section of a sphere by a plane Equations of a circle.

4.09 Interpretation of the equations $S + \lambda S' = 0$ and $S + \lambda U = 0$.

4.10 Relative positions of two spheres -

i) Non-intersecting ii) Intersecting iii) Touching spheres (internally, externally)

4.11 Condition of orthogonality.

5.00 Divisibility of Integers: (12 Periods) (15 Marks)

5.01 Natural numbers.

5.02 Peano's axioms.

5.03 Well ordering principle (statement only).

5.04 Principle of mathematical induction.

5.05 Examples on principle of mathematical induction

5.06 Divisibility - Definition

5.07 If a | b and b | c then a | c (with proof)

5.08 If a | b and a | c then a | (b ± c) (with proof)

5.09 If a | b and a | c then a | (bx + cy) where x and y are any integers. (with proof)

5.10 If a | b and a | bc for every integer c (with proof)

5.11 If a | b and b | a then a = ± b (with proof)

5.12 Examples - i) If a, b ∈ Z, a | b and b ≠ 0 show that |a| ≤ |b|

ii) If 0 ≤ a < b and b | a show that a = 0

5.13 Division Algorithm (without proof)

5.14 Greatest Common Divisor - Definition

5.15 Theorem : Any two non zero integers a and b have a unique g.c.d. and it can be expressed in the form ma + nb, where m,n ∈ Z (without proof)

5.16 Least Common Multiple -Definition

5.17 Euclidean Algorithm (without proof)

5.18 Examples on G.C.D.

5.19 Prime and Composite numbers

5.20 Unique Factorisation Theorem (without proof)

6.00 Congruence Classes (10 Periods) (10 Marks)

6.01 Partition of a non - empty set

6.02 Equivalence relations - Definition

6.03 Examples on an equivalence relations

6.04 Equivalence classes - Definition

6.05 Examples on equivalence classes

6.06 Theorem Let '~' be and equivalence relation on a set S and a, b ∈ S then

(i) a ∈ [a] (ii) [a] = [b] if and only if a ~ b

(iii) any two equivalence classes are either disjoint or identical.

6.07 Equivalence classes theorem - Every equivalence relation on a non- empty set A induces a partition of A and conversely every partition of A defines an equivalence relation on A (with proof)

6.08 Congruence modulo m - Definition

6.09 Proofs of

(A) If $a \equiv b \pmod m$ then for $a, b, c \in Z$

(i) $(a + c) \equiv (b + c) \pmod m$ and (ii) $ac \equiv bc \pmod m$

(B) If $a \equiv b \pmod m$ and $c \equiv d \pmod m$ then

(i) $(a + c) \equiv (b + d) \pmod m$ (ii) $(a - c) \equiv (b - d) \pmod m$

(iii) $ac \equiv bd \pmod m$

6.10 Definitions of (i) addition modulo m and (ii) multiplication modulo m in Z_n

6.11 Composition table.

6.12 Proof of Fermat's Theorem

6.13 Examples on Fermat's Theorem

7.00 Complex numbers (10 Periods) (10 Marks)

7.01 Notation and Terminology

7.02 Equality of Complex numbers

7.03 Addition, Subtraction, Multiplication and Division of complex numbers.

7.04 Complex Conjugate Numbers

7.05 Proposition - If Z_1 and Z_2 are two complex numbers then

(i) $\overline{Z_1 + Z_2} = \overline{Z_1} + \overline{Z_2}$ (ii) $\overline{Z_1 - Z_2} = \overline{Z_1} - \overline{Z_2}$ (iii) $\overline{Z_1 Z_2} = \overline{Z_1}\ \overline{Z_2}$

(iv) $\overline{\left(\dfrac{Z_1}{Z_2}\right)} = \dfrac{\overline{Z_1}}{\overline{Z_2}}$

7.06 Geometric Representation of Complex Numbers.

7.07 Modulus-Amplitude form of a Complex Number (in polar form)

7.08 Theorems on Modulus and Amplitude

(i) $|Z_1 + Z_2| \le |Z_1| + |Z_2| \quad \forall Z_1, Z_2 \in C$

(ii) $|Z_1 Z_2| = |Z_1|\,|Z_2|$ and $\arg Z_1 Z_2 = \arg Z_1 + \arg Z_2$

(iii) If $Z_1, Z_2 \in C$ then $\left|\dfrac{Z_1}{Z_2}\right| = \dfrac{|Z_1|}{|Z_2|}$

and $\arg \dfrac{Z_1}{Z_2} = \arg Z_1 - \arg Z_2$

(iv) If $Z_1, Z_2 \in C$ then
$|Z_1 - Z_2| \ge |Z_1| - |Z_2|$

7.09 Geometric Representation of the sums, the differences, the product and quotient of two complex numbers.

7.10 Complex number as a two dimensional vector.

7.11 Examples on each topic.

8.00 De Moivre's Theorem (10 Periods) (15 Marks)

8.01 De Moivre's Theorem for rational indices (with proof)

8.02 n^{th} Roots of unity and their geometrical representation.

8.03 n^{th} Roots of a Complex Number

8.04 Examples on above topics.

Paper III (E) : Graph Theory and Algebra

1.00 Graphs : **(10 Periods) (10 Marks)**

1.01 Definitions, Simple graph, Finite and Infinite graphs

1.02 Degrees, Degree of a Vertex

Lemma 1.021 Handshaking lemma with proof and verification

Theorem 1.022 The number of odd vertices (vertex having odd degree) in a graph is always even (with proof)

1.03 Subgraph, Spanning subgraph, Definition of Induced Subgraph, Edge - induced sub graph with illustration

1.04 Isomorphism of two graphs, Examples of Isomorphic graphs.

1.05 Types of graphs

Complete graph, regular graph, Bipartite graph (A bigraph), Complete bipartite graph, Null graph Definitions and examples of each type of graphs.

1.06 Operations on graphs

(a) Removal of a Vertex (b) Addition of a Vertex (c) Removal of an edge (d) Addition of an edge Definitions & illustration

1.07 Union of graphs

1.08 Intersection of graphs

1.09 Sum of graphs

1.10 Product of graphs

1.11 Complement of a graph

1.12 The Ring sum of graphs

1.13 Fusion of vertices Definitions & illustration

2.00 Connected Graphs **(8 Periods) (10 Marks)**

2.01 Walks, Paths and Cycles (Circuits) Definitions and examples

2.02 Connected graphs, Disconnected graph, Component of a graph. Illustrations

Theroem 2.021 Let G be a simple graph with p vertices, q edges and k components then $p-k \le q \le 1/2\,(p-k)\,(p-k+1)$ (with proof)

Corollary

2.021 Let G be a connected graph with p vertices, q edges then

$p - 1 \le q \le 1/2\, p(p-1)$

Theorem 2.022 A graph G is bipartite if and only if G has no odd cycles (with proof)

2.03 Cutvertices and Bridges Definitions and illustrations

2.04 Connectivity : Vertex connectivity ($k(G)$), definition & examples, edge connectivity ($\lambda(G)$), definition and examples

Theorem 2.041 For any graph G, $k(G) \le \lambda(G) \le \delta(G)$ Where $\delta(G)$ = minimum degree of a vertex in G (with proof)

Verification of theorem by examples

3.00 Trees **(8 Periods) (10 Marks)**

3.01. Trees : Definition and examples

Theorem 3.011 : A graph G = (V,E) is a tree if and only if any two distinct vertices are joined by a unique path (with proof)

Theorem 3.012 : Let G be a graph with p vertices then the following statements are equivalent

i) G is a tree ii) G is acyclic and (No. of edges in G) = p - 1

iii) G is connected and e(G) = p-1 (with proof)

Theorem 3.13 Every non-trivial tree (with two or more vertices) has atleast two pendent vertices (with proof)

3.02 Centres

Eccentricity of a vertex, centre, radius and diameter of a graph, Definition with illustrations.

Theorem 3.21 A tree has either one or two centres (with proof)

3.03 Spanning trees : Definition

Theorem 3.31 Every connected graph has a spanning tree (with proof)

3.04 Fundamental circuits (Cycles)

3.05 Fundamental cutsets, Definition of cutsets, Definition of Fundamental cutset with illustrations. Cutset rank of G(η (G))

3.06 Rooted and Binary trees Definition, illustrations

Theorem 3.61 Prove that in a binary tree with n vertices

i) The number of vertices is odd ii) p = (n+1)/2, where p is number of pendent vertices iii) q=p-1, where q is number of non-pendent vertices (with proof)

3.07 Kruskal's algorithm for shortest spanning tree

Weighted graph (Definition) and example, Explanation of algorithm with example

4.00 Eularian and Hamiltonian graphs (6 Periods) (5 Marks)

4.01 Königsberge seven bridge problem (Explaination)

4.02 Eulerian graphs

Eulerian trail, Definitation of Eularian graph with example

Theorem 4.21 Let G be a connected graph with p vertices (p ≥ 3). Then prove that the following statements are equivalent i) A graph G is Eulerian graph ii) Every vertex of G is of even degree iii) All edges of G are partitioned into disjoint cycles.

4.03 Hamiltonian graphs

Hamiltonian path, Hamiltonian cycle, Hamiltonian graph (Definitation), The Travelling salesman problem (explanation)

4.04 Illustrated Examples.

5.00 Planar and Dual graphs (5 Periods) (5 Marks)

5.01 Planar graph and plane graph (Definition & examples)

Theorem 5.011 (Euler's Theorem) (with proof)

If G is a connected plane graph with p vertices and q edges then p - q + r = 2 , where r = number of faces of G

Example 5.011 : Let G be a 2-connected planar graph with p vertices and q edges. If p ≥ 3 then prove that q ≤ 3p - 6

5.02 Kuratowski's two graphs K_5 and $K_{3,3}$

Example 5.021 Show that K_5 is not a planar graph

Example 5.022 Let G be a 2 - connected planar graph without a triangle. If G has p - vertices and q edges then q ≤ 2p - 4

Example 5.023 Show that $K_{3,3}$ (Kuratowski's second graph) is not a planar graph

5.03 Geometrical dual Definition & examples

5.04 Colouring of a graph Definition and illustrations

Theorem 5.04: (without proof) A connected graph G is two colourable if and only if G is a bipartite graph.

Corollary 5.41: (with proof) prove that if T is a tree with V(T) ≥ 2 then tree is 2-chromatic (i.e. χ(T) = 2)

6.00 **Matrix representation of a graph** (5 Periods) (5 Marks)

6.01 The Adjacency Matrix, Definition, examples & properties

6.02 The Incidence Matrix, Definition, examples & properties

7.00 **Directed graphs (Digraph)** (3 Periods) (5 Marks)

7.01 Digraphs, Definition, examples, out degree & indegree of a vertex

7.02 The Adjacency Matrix of a digraph, examples

7.03 The Incidence Matrix of digraph, examples

7.04 Balanced digraph, Regular digraph

8.00 Divisibility of integers. (12 Periods) (15 Marks)

8.01 Natural numbers.

8.02 Peano's axioms.

8.03 Well ordering principle. (statement only).

8.04 Principle of mathematical induction.

8.05 Examples on principle of mathematical induction

8.06 Divisibility - Definition

8.07 If a | b and b | c then a | c (with proof)

8.08 If a | b and a | c then a | (b ± c) (with proof)

8.09 If a | b and a | c then a | (bx + cy) where x and y are any integers. (with proof)

8.10 If a | b and a | bc for every integer c (with proof)

8.11 If a | b and b | a then a = ± b (with proof)

8.12 Examples - i) If a, b ∈ Z, a | b and b ≠ 0 show that |a| ≤ |b|

ii) If 0 ≤ a < b and b | a show that a = 0

8.13 Division Algorithm (without proof)

8.14 Greatest Common Divisor - Definition

8.15 Theorem : Any two non zero integers a and b have a unique g.c.d. and it can be expressed in the form ma + nb, where m, n ∈ Z (without proof)

8.16 Least Common Multiple-Definition

8.17 Euclidean Algorithm (without proof)

8.18 Examples on G.C.D.

8.19 Prime and Composite numbers

8.20 Unique Factorisation Theorem (without proof)

9.00 **Congruence Classes** (8 Periods) (10 Marks)

9.01 Partition of a non - empty set

9.02 Equivalence relations - Definition

9.03 Examples on an equivalence relations

9.04 Equivalence classes - Definition

9.05 Examples on equivalence classes

9.06 Theorem Let '~' be and equivalence relation on a set S and a, b ∈ S then

(i) a ∈ [a] (ii) [a] = [b] if and only if a ~ b

(iii) any two equivalence classes are either disjoint or identical.

9.07 Equivalence classes theorem - Every equivalence relation on a non-empty set A induces a partition of A and conversely every partition of A defines an equivalence relation on A (with proof)

9.08 Congruence modulo m - Definition

9.09 Proofs of (A) If $a \equiv b \pmod m$ then for all $c \in Z$

(i) $(a + c) \equiv (b + c) \pmod m$ and (ii) $ac \equiv bc \pmod m$

(B) If $a \equiv b \pmod m$ and $c \equiv d \pmod m$ then

(i) $(a + c) \equiv (b + d) \pmod m$ (ii) $(a - c) \equiv (b - d) \pmod m$

(iii) $ac \equiv bd \pmod m$

9.10 Definitions of (i) addition modulo m and (ii) multiplication modulo m in Z_n

9.11 Composition tables

9.12 Proof of Fermat's Theorem

9.13 Examples on Fermat's Theorem

10.00 Complex numbers (10 Periods)(10 Marks)

10.01 Notation and Terminology

10.02 Equality of Complex numbers

10.03 Addition, Subtraction, Multiplication and Division of complex numbers.

10.04 Complex Conjugate Numbers

10.05 Proposition - If Z_1 and Z_2 are two complex numbers then

(i) $\overline{Z_1 + Z_2} = \overline{Z_1} + \overline{Z_2}$ (ii) $\overline{Z_1 - Z_2} = \overline{Z_1} - \overline{Z_2}$ (iii) $\overline{Z_1 Z_2} = \overline{Z_1}\ \overline{Z_2}$ (iv) $\overline{\left(\frac{Z_1}{Z_2}\right)} = \frac{\overline{Z_1}}{\overline{Z_2}}$

10.06 Geometric Representation of Complex Numbers

10.07 Modulus-Amplitude form of a Complex Number (in polar form)

10.08 Theorems on Modulus and Amplitude

(i) $|Z_1 + Z_2| \le |Z_1| + |Z_2|$ $\forall Z_1, Z_2 \in C$

(ii) $|Z_1 Z_2| = |Z_1|\,|Z_2|$ and $\arg Z_1 Z_2 = \arg Z_1 + \arg Z_2$

(iii) If $Z_1, Z_2 \in C$, then $\left|\frac{Z_1}{Z_2}\right| = \frac{|Z_1|}{|Z_2|}$ and $\arg \frac{Z_1}{Z_2} = \arg Z_1 - \arg Z_2$

(iii) If $Z_1, Z_2 \in C$, then $|Z_1 - Z_2| \ge |Z_1| - |Z_2|$

10.09 Geometric Representation of the sums, the differences, the product and quotient of two complex numbers.

10.10 Complex number as a two-dimensional vector.

10.11 Examples on each topic.

11.00 De Moivre's Theorem (10 Periods) (15 Marks)

11.01 De Moivre's Theorem for rational indices (with proof)

11.02 n^{th} Roots of unity and their geometrical representation.

11.03 n^{th} Roots of a Complex Number

11.04 Examples on above topics.

IMP Note - The weightage of marks will change according to the patteren of the question paper with slight variations.

॥ अंतरी पेटवू ज्ञानज्योत ॥

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जा.क्र. उमावि/१२ /विविशा/२६१/२००३ दिनांक :२१/०१/२००३

विषय :- विज्ञान विद्याशाखेतील प्रथमवर्ष विज्ञान -पदार्थविज्ञान, रसायनशास्त्र व
एम्.एस्सी. भाग-१ रसायनशास्त्र अभ्यासक्रमातील दुरुस्ती व
प्रथमवर्ष विज्ञान -गणित विषयाच्या मुल्यभार (Weightage of Marks) बाबत. ..

संदर्भ :- विद्यापीठाचे परिपत्रक क्र. -
१) पदार्थविज्ञान - २७/२००२, जा.क्र.उमवि/१२/विज्ञान विद्याशाखा/४९०/२००२,
दिनांक ०१.०७.२००२.
२) रसायनशास्त्र - ३७/२००२, जा.क्र.उमवि/१२/विज्ञान विद्याशाखा/५८१/२००२,
दिनांक ११.०७.२००२ आणि
४९/२००२, जा.क्र.उमवि/१२/विज्ञान विद्याशाखा/७१७/२००२,
दिनांक २३.०७.२००२.
३) गणित - ४१/२००२, जा.क्र.उमवि/१२/विज्ञान विद्याशाखा/६३९/२००२,
दिनांक १६.०७.२००२.

महोदय,

सदर्भिय पत्रान्वये आपणांस सुधारित अभ्यासक्रमाच्या प्रती पाठविण्यात आलेल्या आहेत. मा.विद्यापीठ अधिकार मंडळाने घेतलेल्या निर्णयानुसार त्यात दुरुस्त्या सुचविलेल्या असून तसेच प्रथमवर्ष विज्ञान-गणित विषयाचा मुल्यभार मान्य केलेला आहे. त्याची प्रत आपल्या माहितीसाठी व पुढील योग्य त्या कार्यवाहीसाठी सोबत जोडून पाठविण्यात येत आहे. तरी आपण सदर बाब संबंधीतांच्या निदर्शनास आणून द्यावे.

कळावे ही विनंती.

सोबत :- वरीलप्रमाणे.

उपकुलसचिव.

प्रति,

मा.प्राचार्य,
सर्व कला, विज्ञान आणि वाणिज्य महाविद्यालये.

प्रतिलिपी :-
१) मा.अधिष्ठाता, विज्ञान विद्याशाखा.
२) मा.अध्यक्ष, पदार्थविज्ञान / रसायनशास्त्र / गणित अभ्यासमंडळ, उ.म.वि., जळगांव.
३) मा.परिक्षा नियंत्रक (पाच प्रती)
४) उपकुलसचिव, संलग्नता विभाग, उ.म.वि., जळगाव
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६) सहा.कुलसचिव, परीक्षा विभाग, संबंधित विद्याशाखा, उ.म.वि., जळगाव.
७) सभा व दप्तर विभाग, उ.म.वि., जळगाव.
८) मा.कुलगुरु कार्यालय, उ.म.वि., जळगाव.
९) मा.कुलसचिव कार्यालय, उ.म.वि., जळगाव.

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॥ अंतरी पेटवू ज्ञानज्योत ॥

NORTH MAHARASHTRA UNIVERSITY, JALGOAN.

Weightage of Marks for F.Y.B.Sc. Mathematics.

Paper-I : CALCULUS.

	Topic.		Weightage.
1	Sequence	:	08 Marks.
2.	Series	:	08
3	Indeterminate forms	:	5/6
4	Continuity	:	08
5.	Mean Value Theorems	:	12
6.	Successive Differentiation	:	11
7.	Taylor's and Maclaurin's Thim	:	08
8.	Integration	:	10
9.	Reduction Formulae	:	11
10.	Application of Integration	:	18

Paper-II : MATRICES AND DIFFERNTIAL EQUATIONS.

1.	Adjoint and Inverse	:	16
2.	Rank of Matrix	:	16
3.	System of Linear Equations	:	12
4.	Eigen Values & Eigen Vectors	:	06
5.	Differential Equations of first order & first degree	:	22
6.	Diff^{n}. eq^{n}s. of Ist order & higher degree	:	10
7.	Application diff. Equations	:	18

PAPER- III (A) GEOMETRY & ALGEBRA.

1. Co-ordinates in space	:	06
2. Plane	:	10
3. Line	:	16
4. Sphere	:	18
5. Divisibility of Integers	:	13
6. Congruence Classes	:	11
7. Complex Numbers	:	14
8. De-Moivre's Theorem	:	12

PAPER -III (B) GRAPH THEORY AND ALGEBRA.

1. Graphs	:	08
2. Connected graphs	:	08
3. Trees	:	14
4. Eulerian & Hamiltonian graph	:	05
5. Planer & Duel graphs	:	08
6. Matrix Representation	:	06
7. Directed graphs	:	06
8. Divisibility of Integres	:	13
9. Congruence Classes	:	11
10. Complex Numbers	:	14
11. De-Moivre's Theorem	:	12

Note : Subject to change of 10% variations of marks in the question paper.