ಬೆಂಗಳೂರು
ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

BENGALURU
CITY UNIVERSITY

Office of the Registrar, Central College Campus, Dr. B.R. Ambedkar Veedhi, Bengaluru – 560 001.
PhNo.080-22131385, E-mail: registrarbcu@gmail.com

No.BCU/BoS/Mathematics-UG /339 /2022-23 Date: 13.12.2022.

NOTIFICATION

Sub: B.Sc. V & VI Semesters Mathematics Syllabus of Bengaluru City University-reg.

Ref: 1.University Notification No.BCU/BoS/Science-UG Syllabus/87/2020-21 dated.04.09.2020
2. Recommendations of the Board of Studies in the Mathematics (UG)
3. Approval of the Academic Council in its meeting held on 29.10.2022
4. Approval of the Vice-Chancellor dated. 12.12.2022.

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In pursuance to the recommendations of the BoS in Mathematics (UG) and the approval of the Academic Council cited at reference (2 & 3) above, the B.Sc. V & VI Semester Mathematics Syllabus of Bengaluru City University effective from the academic year 2022-23, is hereby notified for information of the concerned.

The copy of the Syllabus is notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR

To:

The Registrar (Evaluation), Bengaluru City University, Bengaluru.

Copy to;

1. The Dean, Faculty of Science, BCU.
2. The Chairman & Members of BoS in Mathematics (UG), BCU.
3. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), BCU.
4. Office copy / Guard file / University Website: www.bcu.ac.in

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BE BOUNDLESS

BENGALURU CITY UNIVERSITY

B.Sc. Mathematics
(V & VI Semester)

(CHOICE BASED CREDIT SYSTEM)

(SEMESTER SCHEME)

2022-23 onwards

PROCEEDINGS OF THE BOS MEETING IN MATHEMATICS (UG) CONDUCTED ON 21 SEPTEMBER 2022 IN THE DEPARTMENT OF MATHEMATICS, BENGALURU CITY UNIVERSITY, CENTRAL COLLEGE CAMPUS, BENGALURU

The following members attended the BOS meeting to finalize the syllabi of mathematics papers of BSc fifth and sixth semesters under CBCS scheme:

1. Dr Ramesh B Kudenatti	Chairman	
2. Dr D Sujatha	Member	ABSENT
3. Prof T Ganghadharaiah	Member	
4. Dr D Radhakrishna	Member	
5. Dr M S Nagashree	Member	
6. Prof V S Ramesh Babu	Member	
7. Prof Vittal V Kulkarni	Member	
8. Dr S B Sathyanarayana	Member	
9. Dr S Bhagya	Member	
10. Prof Sanjaykumar Pattankar	Member	ABSENT

The esteem members discussed in deep the content of the syllabi of mathematics and finalized syllabi of both semesters.

The Chairman thanked all the members for their cooperation.

Ramesh B Kudenatti
Chairman, BOS (UG)

Chairperson
Department of Mathematics
Bengaluru City University
Central College Campus
Bengaluru-560001.

ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

BENGALURU CITY UNIVERSITY

BENGALURU CITY UNIVERSITY, BENGALURU

DEPARTMENT OF MATHEMATICS

Syllabi for Mathematics Papers of BSc Fifth and Sixth Semesters Under Choice Based Credit System (CBCS)

Effective from the academic year

2022 – 2023

Structure of B.Sc. Mathematics Papers

Subjects	Paper	Instruction hrs/week	Duration of Exam(3hrs)	Marks			Credits
				IA	Exam	Total	
I Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
II Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
III Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
IV Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
V Semester							
Mathematics papers with practicals of 3 credits each	Theory Prac. Theory Prac.	3 3 3 3	3 3 3 3	30 15 30 15	70 35 70 35	100 50 100 50	2 1 2 1
VI Semester							
Two Mathematics papers with practicals of 3 credits each	Theory Prac. Theory Prac.	3 3 3 3	3 3 3 3	30 15 30 15	70 35 70 35	100 50 100 50	2 1 2 1

MISSION AND VISION OF THE NEW SYLLABUS IN MATHEMATICS

Mission

- Improve retention of mathematical concepts in the student.
- To develop a spirit of inquiry in the student.
- To improve the perspective of students on mathematics as per modern requirement.
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and to understand the basic structure of mathematics.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of FOSS tools on a computer.
- To make the learning process student-friendly by having a shift in focus in mathematical teaching, especially in the mathematical learning environment.
- Exploit techno-savvy nature in the student to overcome math-phobia.
- Propagate FOSS (Free and open source software) tools amongst students and teachers as per vision document of National Mission for Education.
- To set up a mathematics laboratory in every college in order to help students in the exploration of mathematical concepts through activities and experimentation.
- To orient students towards relating Mathematics to applications.

Vision

- To remedy Math phobia through authentic learning based on hands-on experience with computers.
- To foster experimental, problem-oriented and discovery learning of mathematics.
- To show that ICT can be a panacea for quality and efficient education when properly integrated and accepted.
- To prove that the activity-centered mathematics laboratory places the student in a problem solving situation and then through self exploration and discovery habituates the student into providing a solution to the problem based on his or her experience, needs, and interests.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners.
- To provide scope for greater involvement of both the mind and the hand which facilitates cognition.
- To ultimately see that the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a program that paves the way to seek and understand the world around them. A possible by-product of such an exercise is that math-phobia can be gradually reduced amongst students.
- To help the student build interest and confidence in learning the subject.

Support system for Students and Teachers in understanding and learning FOSS TOOLS:

As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open source software like Scilab, maxima, octave, Geogebra, Python and others.

FIFTH SEMESTER

MATHEMATICS V

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students) **(42 hours)**

THEORY

1. ALGEBRA - IV

Rings, Integral Domains, Fields

Rings, Types of Rings properties of rings – Rings of integers modulo n – Subrings – Ideals, Principal, Prime and Maximal ideals in a commutative ring – examples and standard properties following the definition – Homomorphism, Isomorphism – Properties – Quotient rings – Integral Domain- Fields - properties following the definition – Fundamental Theorem of Homomorphism of Rings - Every field is an integral domain – Every finite integral domain is a field – Problems.

(14 hours)

2. MATHEMATICAL METHODS - II

Calculus of Variation

Variation of a function $f = f(x, y, y')$ – variation of the corresponding functional – extremal of a functional – variational problem – Euler's equation and its particular forms – Examples – standard problems like geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem –Isoperimetric problems. Application Problems.

(14 hours)

3. NUMERICAL METHODS - I

Finite differences – Definition and properties of $\Delta, \nabla, \delta, \mu$ and E, the relation between them – The n^{th} differences of a polynomial, Factorial notations, Separation of symbols, Divided differences and related theorems.

Newton –Gregory forward and backward interpolation formulae – Lagrange's and Newton's interpolation formulae for unequal intervals - Inverse interpolation.

Numerical Integration: Quadrature formula – Trapezoidal rule -Simpon's 1/3 and 3/8 rules- problems. Application Problems.

(14 hours)

Suggested distribution of lecture hours.

1. Algebra IV: 1 hour /week.
2. Calculus Of Variation: 1 hours/week
3. Numerical Methods I : 1 hours/week

Text Books/open source materials

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3. M D Raisinghania, *Vector calculus*,S Chand Co. Pvt. Ltd., 2013.
4. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
5. www.scilab.org.
6. **wxmaxima**.sourceforge.net
7. www.geogebra.org

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomasand R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*
6. B Spain,*Vector Analysis* , ELBS, 1994.
7. D E Bournesand, P C Kendall, *Vector Analysis,* ELBS, 1996.
8. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India,2012.
9. Numerical Analysis by R L Burden and J D Faires.

Useful web links:

http://www.themathpage.com/

1. http://www.abstractmath.org/
2. http://ocw.mit.edu/courses/mathematics/

3. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
4. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
5. http://mathworld.wolfram.com/Calculus.html
6. http://www.univie.ac.at/future.media/moe/galerie.html
7. http://www.math.gatech.edu/~harrell/calc/
8. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
9. http://math.fullerton.edu/mathews/numerical.html
10. http://www.onesmartclick.com/engineering/numerical-methods.html

PRACTICALS –V

Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS) tools for computer programs

Sl. No.	Title
	I. Ring Theory
1	To verify given ring is a commutative ring.
2	To verify given ring is a ring with unity.
3	To verify given ring is a ring with/without zero divisors
4	To verify given ring is a field.
	II MATHEMATICAL METHODS (Calculus Of Variation)
5	Variational problems-using Euler's general form
6	Variational problems-using Particular forms of Euler's equation with equations independent of both x and y
7	Variational problems-using Particular forms of Euler's equation with equations independent of y
	III Numerical Analysis
8	Newton's Forward interpolation formula
9	Newton's Backward interpolation formula
10	Trapezoidal rule

11	Simpsons $1/3^{rd}$ rule
12	Simpsons $3/8^{th}$ rule

(3 hours/ week per batch of not more than 15 students)

FIFTH SEMESTER
MATHEMATICS – VI

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 15 students) **(42 HOURS)**

THEORY

1. CALCULUS - IV

Differential Calculus of Scalar and Vector Fields

Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field – divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, Problems. Applications (14 hours)

2. CALCULUS – V

Line and Multiple Integrals

Definition of line integral and basic properties examples evaluation of line integrals.

Definition of double integral – its conversion to iterated integrals .Evaluation of double integrals by change of order of integration and by change of variables– computation of plane and surface areas, volume underneath a surface and volume of revolution using double integrals.

Definition of triple integral and evaluation – change of variables – volume as a triple integral. Applications. (18 hours)

3. INTEGRAL THEOREMS

Green's theorem (with proof) - Direct consequences of the theorem. The Divergence theorem (with proof) - Direct consequences of the theorem. The Stokes' theorem (with proof) - Direct consequences of the theorem.

(10 hours)

Suggested distribution of lecture hours

1. Differential Calculus Of Scalar And Vector Fields: 1 hour /week.
2. Calculus VI (Line and Multiple Integrals and Integral theorems): 2 hours/week

Text Books/open source materials

1. R. Weinstock, *Calculus of Variation*, Dover, 1970.
2. M. D. Raisinghania, *Vector Calculus*, S Chand Co. Pvt. Ltd., 2013.
3. www.scilab.org
4. **wxmaxima**.sourceforge.net
5. www.geogebra.org

Reference Books

1. F B Hildebrand, *Methods in Applied Mathematics*,
2. B Spain, *Vector Analysis* , ELBS, 1994.
3. D E Bournesand, P C Kendall, *Vector Analysis*, ELBS, 1996.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
3. http://mathworld.wolfram.com/Calculus.html
4. http://www.univie.ac.at/future.media/moe/galerie.html
5. http://www.math.gatech.edu/~harrell/calc/

PRACTICALS –VI

Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS)tools for computer programs

(3 hours/ week per batch of not more than 10 students)

Sl. No.	Title
	I. Vector Differential Calculus
1	Gradient and Laplacian of a scalar field ϕ
2	Curl of a vector field f
3	Divergence of a vector field f
	II. Line and Multiple integrals
4	Evaluation of line integrals with constant limits
5	Evaluation of line integrals with variable limits
6	Evaluation of double integral with constant limits
7	Evaluation of double integral with variable limits
8	Evaluation of triple integral with constant limits
9	Evaluation of triple integral with variable limits
	III. Integral Theorems
10	Verification of Green's theorem
11	Verification of Gauss divergence theorem
12	Verification of Stokes theorem

SIXTH SEMESTER

MATHEMATICS - VII

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 15 students) **(42 HOURS)**

THEORY

1. ALGEBRA –V

Linear Algebra

Vector space – Examples – Properties – Subspaces – criterion for a subset to be a subspace –linear span of a set - linear combination – linear independent and dependent subsets – Basis and dimensions– Standard properties – Examples illustrating concepts and results.

Linear transformations – properties – matrix of a linear transformation – change of basis – range and kernel – rank and nullity – Rank – Nullity theorem –Eigenvalues and eigenvectors of linear transformation - Application Problems. (14 hours)

2. DIFFERENTIAL EQUATIONS III

a). Orthogonal Curvilinear Coordinates

Definition of orthogonal curvilinear coordinates. Fundamental vectors or base vectors, Scale factors or material factors - Quadratic differential form. Spherical, Cartesian, Cylindrical co-ordinate systems- Theorem: the Spherical and cylindrical coordinate systems are orthogonal curvilinear coordinate system- problems on conversion of one system to another. (10 hours)

b). Partial Differential Equations

Total differential equations-Necessary condition for the equation $Pdx+ Qdy +Rdz = 0$ to be integrable - Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Formation of partial differential equation - Equations of First order Lagrange's linear equation – Charpit's method, Standard types of first order non-linear partial differential equation (By known substitution).

Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral

Solution of one – dimensional heat equations, Solution of one – dimensional wave equations using Fourier series- Application Problems. (18 hours)

Suggested distribution of lecture hours:

1. Algebra-V (Linear Algebra) : 1 hours / week.
2. Differential Equations III: 2 hours / week

Text Books/open source materials

1. Krishnamoorty V K and Mainra V P and Arora J L, *An Introduction to Linear Algebra*, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
2. M. D. Raisinghania, *Vector Calculus,* S Chand Co. Pvt. Ltd., 2013.
3. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
4. www.scilab.org
5. **wxmaxima**.sourceforge.net
6. www.geogebra.org

Reference Books

1. G Strang, MIT open courseware (http://ocw.mit.edu/courses).
2. B Spain, *Vector Analysis* , ELBS, 1994.
3. D E Bournes and, P C Kendall, *Vector Analysis,* ELBS, 1996.
4. Frank Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 1972.
5. GF Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
6. S Narayanan & T K Manicavachogam Pillay, *Differential Equations.*: S V Publishers Private Ltd., 1981.
7. I N Sneddon, *Elements of Partial Differential Equations*, 3rd ed.: Mc. Graw Hill., 1980.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://mathworld.wolfram.com/Calculus.html

3. http://www.math.gatech.edu/~harrell/calc/
4. http://tutorial.math.lamar.edu/classes/de/de.aspx
5. http://www.sosmath.com/diffeq/diffeq.html
6. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –VII(Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS) tools for computer programs

(3 hours/ week per batch of not more than 15 students)

Sl. No.	Title
	I Linear Algebra
1	Expressing a vector as a linear combination of given set of vectors.
2	Examples on linear dependence and independence of vectors.
3	Expressing a vector as a linear combination of given set of vectors.
4	Examples on linear dependence and independence of vectors.
5	Verifying whether a given transformation is linear or not.
6	Finding matrix of a linear transformation.
7	Verification of rank and nullity theorem.
	II Total Differential and Partial Differential Equations
8	Solutions to the problems on total and simultaneous differential equations.
9	Solutions to the problems on different types of partial differential equations.
10	Solving second order linear partial differential equations in two variables with constant coefficients.
11	Solution of one dimensional heat equation
12	Solution of one dimensional wave equation

SIXTH SEMESTER

MATHEMATICS - VIII

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students) **(42 HOURS)**

THEORY

1. ANALYSIS - III

Complex Analysis

Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula. Functions of a complex variable- limit, continuity and differentiability of a complex function. Analytic function- Cauchy-Riemann equations in Cartesian and polar forms-Sufficiency conditions for analyticity (Cartesian form only)-Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given- Milne Thomson method.

Complex integration- properties and problems. Cauchy's integral theorem-proof using Green's theorem- Direct consequences. Cauchy's integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals - Cauchy's inequality with proof – Liouville's theorem with proof. Fundamental theorem of algebra with proof.

Transformations – conformal transformation – some elementary transformations namely Translation, Rotation, Magnification and Inversion - examples.

The bilinear transformation (B.T.)-cross ratio-invariant points of B.T.-properties-

(i) B.T. sets up a one to one correspondence between the extended z-plane and the extended w-plane.
(ii) Preservation of cross ratio under a B.T.
(iii) B.T. transforms circles onto circles or straight lines.

Problems on finding a B.T., and finding images under a B.T.and invariant points of a B.T. Discussion of transformations $w = z^2$, $w = \sin z$, $w = \cos z$, $w = \sinh z$, $w = \cosh z$, $w = \frac{1}{2}\left(z + \frac{1}{z}\right)$ and $w = e^z$. Applications. (28 hours)

2. NUMERICAL METHODS – II

Numerical solutions of equations – method of successive bisection- method of false position – Newton-Raphson method.

Numerical solutions of non-homogeneous system of linear algebraic equations in three variables by Jacobi's method and Gauss-Seidel method. Computation of the largest eigenvalue of a square matrix by power method.

Solutions of first order linear ordinary differential equations by Taylor's series, Euler's and Euler's modified method and Runge-Kutta 4^{th} order method. Applications

(14 hours)

Suggested distribution of lecture hours:

1. Analysis-III (Complex Analysis): 2 hours / week.
2. Numerical Methods-II: 1 hour / week

Text Books/open source materials

1. S Shanthinarayan, *Complex Analysis*, S Chand Co. Pvt. Ltd., 2012.
2. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
3. www.scilab.org
4. **wxmaxima**.sourceforge.net
5. www.geogebra.org

Reference Books

1. R V Churchil & J W Brown, *Complex Variables and Applications*, 5th ed.: McGraw Hill Companies., 1989.
2. L V Ahlfors, *Complex Analysis*, 3rd ed.: Mc Graw Hill. , 1979.
3. A R Vashista, *Complex Analysis*, Krishna Prakashana Mandir, 2012.
4. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India, 2012.

Useful web links:

1. http://www.mathcs.org/analysis/reals/index.html
2. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
3. http://math.fullerton.edu/mathews/numerical.html

4. http://www.onesmartclick.com/engineering/numerical-methods.html

PRACTICALS –VIII

Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS) tools for computer programs

(3 hours/ week per batch of not more than 10 students)

Sl. No.	Title
	I Complex Analysis
1	Verifying the given complex function (Cartesian and polar) is analytic.
2	Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
3	Verifying real and imaginary parts of an analytic function being harmonic
4	Construction of analytic functions by Milne-Thomson method.
5	Examples connected with Cauchy's integral theorem and Cauchy's integral formula.
	II Numerical Analysis
6	Solution of an equation using bisection and Regula-Falsi methods
7	Solution of an equation by Newton-Raphson method.
8	Solution of system of equations by Gauss-Jacobi method.
9	Solution of system of equations by Gauss-Seidel method.
10	Finding the largest eigenvalue by Power method.
11	Solving ordinary differential equation by modified Euler's method.
12	Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

PATTERN OF THE QUESTION PAPER

FROM 1st TO 4th SEMESTER

Time:3 Hours **Max.Marks:70**

I	Answer any FIVE of the following (8 questions are given)	5 × 2 = 10 Marks
II	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
III	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
IV	Answer any TWO of the following (03 questions are given)	2x 5 = 10 Marks
V	Answer any TWO of the following (03 questions are given)	2x 5 = 10 Marks
VI	Answer any TWO of the following (03 questions are given). Questions to be taken only from Application part	2x 5 = 10 Marks

PATTERN OF THE QUESTION PAPER

FOR 5th and 6th SEMESTER B.Sc

I	Answer any FIVE of the following (EIGHT questions are given)	5 × 2 = 10 Marks
II	Answer any THREE of the following (FIVE questions are given)	3 × 5 = 15 Marks
III	Answer any THREE of the following (FIVE questions are given)	3 × 5 = 15 Marks

IV	Answer any THREE of the following (FIVE questions are given)	3× 5 = 15 Marks
V	Answer any THREE of the following (FIVE questions are given). Questions to be chosen only from Application part	3×5 = 15 Marks