# GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)

## BEGUMPET, HYDERABAD

### SEMESTER-I

### DIFFERENTIAL AND INTEGRAL CALCULUS

**UNIT-I**

**Partial Differentiation**: Introduction- Functions of two variables-Neighbourhood of a point (a,b)-Continuity of a function of two variables .Continuity of a point-Limit of a function of two variables-Partial Derivatives – Geometrical representation of a function of two variables –Homogeneous functions.

**UNIT-II**

**Theorems on Total differentials** –Composite functions-Differentiation of composite functions-Implicit functions-Equality of $f_{xy}$(a,b) and $f_{yz}$(a,b)--Taylor's theorem for a function of two variables-Maxima and Minima of functions of two variables-Lagrange's method of undetermined multipliers.

**UNIT-III**

**Curvature and Evolutes**: Introduction-Definition of curvature-Radius of curvature-Length of Arc as a Function.Derivative of arc-Radius of curvature- Cartesian Equations – Newtonian Method –Centre of curvature-Chord of Curvature.

**Evolutes:**Evolutes and involutes-properties of the Evolute.

**Envelopes:** One parameter-Family of Curves-consider the family of straight lines-Definition-Determination of envelope.

**UNIT-IV**

**Lengths of plane curves:** Introduction-Expression for the lengths of curves y=f(x)-Expression for the length of arcs x=f(y);x=f(t),y=$\varphi(t)$;r=f($\theta$)

**Volumes and surfaces of Revolution**: Introduction-Expression for the volume obtained by revolving about either axes –expression for volume obtained by revolving about any line-Area of the surface of the frustum of a cone-Expression for the surface of revolution-Pappus Theorems-Surface of revolution.

**Text:**


- Shanti Narayana, P.K.Mittal Differential Calculus,S.Chand, New Delhi
- Shanti Narayana, Integral calculus, S.Chand, New Delhi


**References:**


- William Anthony Granville,Percey F Smith and William Raymond Longley; Elements of the differential and integral calculus
- Joseph Edwards, Differential calculus for beginners
- Smith and Minton, Calculus
- Elis Pine, How to Enjoy Calculus
- Hari Kishan, Differential Calculus



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## SEMESTER-II

## DIFFERENTIAL EQUATIONS

### UNIT-I

**Differential equations of first order and first degree**: Introduction-Equations in which Variables are Separable – Homogeneous Differential Equations-Differential equations Reducible to Homogeneous form-Linear Differential equations-Differential equations Reducible to Linear form-Exact differential equations-Integrating factors-change in variables – Total Differential Equations-Simultaneous Total Differential equations-Equation of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$

### UNIT-II

**Differential equations of first order but not of first degree:** Equations solvable for p-Equation solvable for y- Equation solvable for x- Equations that do not contain x or y – Equations homogeneous in x and y – Equations of the first degree in x and y- Clairaut's equation. **Application of First order differential equations**: Growth and Decay- Dynamics of Tumour Growth- Radioactivity and Carbon Dating-Compound Interest- Orthogonal Trajectories.

### UNIT-III

**Higher order linear differential equations**: Solution of homogenous linear differential equations with constant coefficients- Solution of non-homogeneous differential equations P(D)y= Q(x) with constant coefficients by means of polynomial operators when Q(x)= $be^{ax}.bsinax/bcosax.bx^k.Ve^{ax}$-Method of undetermined coefficients.

### UNIT-IV

**Method of variation of parameters**-Linear differential equations with non-constant coefficients-the Cauchy-Euler Equation-Legendre's Linear Equations-Miscellaneous Differential equations.

**Partial Differential Equations:** Formation and solutions-Equations easily integrable –Linear equation of first order

**Text:**
Zafar Ahsan: Differential equations and their applications

**References:**
Frank Ayres Jr.: Theory and problems of differential equations
Ford, L.R.: Differential equations
Daniel Murray: Differential equations
S.Bala Chandra Rao: Differential equations with applications and Programs
Stuart.P Hastings.J Bryce McLead:Classical Methods in Ordinary Differential Equations

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Semester - V

Paper - V



## 2.12 Linear Algebra

DSC-1E BS:503

Theory: 3 credits and Practicals: 1 credits
Theory: 3 hours /week and Practicals: 2 hours /week

**Objective:** The students are exposed to various concepts like vector spaces , bases , dimension, Eigen values etc.
**Outcome:** After completion this course students appreciate its interdisciplinary nature.

### Unit- I

Vector Spaces : Vector Spaces and Subspaces -Null Spaces, Column Spaces, and Linear Transformations -Linearly Independent Sets; Bases -Coordinate Systems -The Dimension of a Vector Space

### Unit- II

Rank-Change of Basis - Eigenvalues and Eigenvectors - The Characteristic Equation

### Unit- III

Diagonalization -Eigenvectors and Linear Transformations -Complex Eigenvalues - Applications to Differential Equations -Orthogonality and Least Squares : Inner Product, Length, and Orthogonality -Orthogonal Sets.

**Text:**

- David C Lay,*Linear Algebra and its Applications* 4e

**References:**


- S Lang, *Introduction to Linear Algebra*
- Gilbert Strang , *Linear Algebra and its Applications*
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; *Linear Algebra*
- Kuldeep Singh; *Linear Algebra*
- Sheldon Axler; *Linear Algebra Done Right*

Semester - V

Paper - VI

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## 2.14 Integral Calculus

DSE-1E/B BS:506

Theory: 3 credits and Practicals: 1 credits
Theory: 3 hours /week and Practicals: 2 hours /week

**Objective:** Techniques of multiple integrals will be taught.
**Outcome:** Students will come to know about its applications in finding areas and volumes of some solids.

### Unit- I

Areas and Volumes: Double Integrals-Double Integrals over a Rectangle-Double Integrals over General Regions in the Plane-Changing the order of Integration

### Unit- II

Triple Integrals: The Integrals over a Box- Elementary Regions in Space-Triple Integrals in General

### Unit- III

Change of Variables: Coordinate Transformations-Change of Variables in Triple Integrals.

**Text:**

- Susan Jane Colley, *Vector Calculus*(4e)

**References:**


- Smith and Minton, *Calculus*
- Shanti Narayan and Mittal , *Integral calculus*
- Ulrich L. Rohde , G. C. Jain , Ajay K. Poddar and A. K. Ghosh; *Introduction to Integral Calculus*

# GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)

## BEGUMPET, HYDERABAD

### SEMESTER-III

### Real Analysis

**Objective**: The course is aimed at exposing the students to the foundations of analysis which will be useful in understanding various physical phenomena.

**Outcome**: After the completion of the course students will be able to demonstrate an understanding of the theory of sequences and series, continuity, differentiability and integration and will be able to apply the theory in the course to sove a variety of problems at an appropriate level of difficulty.

**Unit- I**

**Sequences**: Limits of Sequences- A Discussion about Proofs-Limit Theorems for SequencesMonotone Sequences and Cauchy Sequences -Subsequences-Lim sup's and Lim inf's-Series-Alternating Series and Integral Tests .

**Unit- II**

**Continuity**: Continuous Functions – Algebra of Continuous Functions - Properties of Continuous Functions -Uniform Continuity - Limits of Functions.

**Unit- III**

**Differentiation**: Basic Properties of the Derivative - The Mean Value Theorem - *L'Hospital Rule - Taylor's Theorem – Maclaurin's Theorem.

**Unit- IV**

**Integration**: The Riemann Integral - Properties of Riemann Integral-Fundamental Theorem of Calculus.

**Text:**

- Kenneth A Ross,Elementary Analysis-The Theory of Calculus

**References**:


- S.C. Malik and Savita Arora, Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International (P) Limited, New Delhi, 1994.
- William F. Trench, Introduction to Real Analysis
- Lee Larson , Introduction to Real Analysis I
- Shanti Narayan and Mittal, Mathematical Analysis
- Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner; Elementary Real analysis
- Sudhir R., Ghorpade, Balmohan V., Limaye; A Course in Calculus and Real Analysis



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## SEMESTER-IV

### Algebra

**Objective**: The course is aimed at exposing the students to learn some basic algebraic structures like groups, rings etc.

**Outcome:** On successful completion of the course students will be able to recognize algebraic structures that arise in matrix algebra, linear algebra and will be able to apply the skills learnt in understanding various such subjects.

**Unit- I**

Groups: Definition and Examples of Groups- Elementary Properties of Groups-Finite Groups –Order of the Group – Order of an element -Subgroups -Terminology and Notation -Subgroup Tests - Examples of Subgroups. Cyclic Groups: Properties of Cyclic Groups - Classification of Subgroups Cyclic Groups.

**Unit- II**

**Permutation Groups**: Definition and Notation -Cycle Notation-Even and Odd Permutations- Properties of Permutations -A Check Digit Scheme Based on D5. Isomorphisms ; Motivation- Definition and Examples -Cayley's Theorem Properties of Isomorphisms -Automorphisms-Cosets and Lagrange's Theorem Properties of Cosets 138 - Lagrange's Theorem and Consequences-An Application of Cosets to Permutation Groups -The Rotation Group of a Cube and a Soccer Ball.

**Unit- III**

**Normal Subgroups and Factor Groups**: Normal Subgroups-Factor Groups -Applications of Factor Groups -Group Homomorphisms - Definition and Examples -Properties of Homomorphisms -The First Isomorphism Theorem. Introduction to Rings: Motivation and Definition -Examples of Rings -Properties of Rings - Subrings. Integral Domains: Definition and Examples - Fields –Characteristics of a Ring.

**Unit- IV**

**Ideals and Factor Rings**: Ideals -Factor Rings -Prime Ideals and Maximal Ideals. Ring Homomorphisms: Definition and Examples-Properties of Ring- Homomorphisms.

**Text:**

- Joseph A Gallian, Contemporary Abstract algebra (9th edition)

**References:**


- Bhattacharya, P.B Jain, S.K.; and Nagpaul, S.R,Basic Abstract Algebra
- Fraleigh, J.B, A First Course in Abstract Algebra.
- Herstein, I.N, Topics in Algebra
- Robert B. Ash, Basic Abstract Algebra
- I Martin Isaacs, Finite Group Theory
- Joseph J Rotman, Advanced Modern Algebra


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GOVERNMENT DEGREE COLLEGE FOR WOMEN

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# DEPARTMENT OF MATHEMATICS

# SYLLABUS, QUESTION BANK FOR PRACTICALS, MODEL PAPER ETC

GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)
BEGUMPET, HYDERABAD

## DEPARTMENT OF MATHEMATICS

# PAPER: VII (A) (Semester - V)
# NUMERICAL ANALYSIS
## Syllabus

**Unit-I: (10 hrs)** 60 hrs

**Error in Numerical computations:** Numbers and their Accuracy, Errors and their computation, Absolute, Relative and Percentage errors, a general error formula, Error in a series approximation.

**Unit-II: (10 hrs)**

**Solution of Algebraic and Transcendental Equations:** The Bisection method, The Iteration method, The method of false Position, Newton-Raphson method, Generalized Newton-Raphson method, Ramanujan's methods, Muller's method.

**Unit-III: (20 hrs)**

**Interpolation:** Errors in polynomial interpolation, Forward differences, Backward differences, Central differences, Symbolic relations, Detection of errors by use of D.Tables, Differences of a polynomial, Newton's formulae for interpolation formulae, Gauss's central difference formula, Stirling's central difference formula.

**Unit-IV: (20 hrs)**

**Interpolation with unevenly spaced points:** Lagrange's formula, Error in Lagrange's formula, Derivation of governing equations, End conditions, Divided differences and their properties, Newton's general interpolation.

**Prescribed text Book:**

Scope as in Introductory Methods of Numerical Analysis by S.S Sastry, Prentice Hall India (4th Edition).

**Reference Books:** 1) Numerical Analysis by G.Shankar Rao, New Age International Publishers, Hyderabad

2) Finite Differences and Numerical Analysis by H.C.Saxena, S.Chand and Company, New Delhi

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Max Marks: 75
Time: $2\frac{1}{2}$hr.

GOVERNMENT DEGREE COLLEGE FOR WOMEN
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CBCS
MODEL PAPER
SEMESTER-V

Numerical Analysis Paper-VII(A)

Date:

## SECTION-A

**Answer All Questions.** 4×10=40 Marks

1. a) Find the percentage error in u=$\log_e(x+y+z)$ at (1±0.01,1±0.001, 1±0.0001).

or

b) If R=$\frac{4x^2y^3}{z^4}$ and errors in x,y,z be 0.001.Compute the relative maximum error in R when x=y=z=1.

2. a) Find a real root of $xe^x=2$ using Regula-falsi method.

b) Find a root of the equation sinx=1-x,using Ramunujan's method.

3. a)From the following table of values of f(x) compute f(0.63)

| | | | | | |
|---|---|---|---|---|---|
| x | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 |
| f(x) | 0.6179 | 0.6554 | 0.6915 | 0.7257 | 0.7580 |

or

b)Find the value of $\tan 16^0$ from the table using Stirling's formula.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| x | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| tanx | 0.00 | 0.0875 | 0.1763 | 0.2679 | 0.3640 | 0.4663 | 0.5774 |

4. a) Evalute f(10) given f(x)=168,192,336 at x=1,7,15 respectively.Use Lagrange interpolation.

or

b) Use Lagrange's interpolation formula to express the function i) $\frac{x^2+x-3}{x^3-2x^2-x+2}$ ii)$\frac{x^2+6x+1}{(x-1)(x+1)(x-4)(x-6)}$ as sums of partial fractions.

## SECTION –B

**Answer any Five Questions.** 5×5=25 **Marks**

5. Derive general error formula.
6. If $u=3v^7-6v$ find the percentage error in u at v=1 if the error in v is 0.05.
7. Find a real root of the equation $x^2-5x+2=0$ by Newton –Raphson's method.
8. Explain Muller's method.
9. Show that i) $\nabla = 1 - E^{-1}$ ii)$\mu = \frac{1}{2}(E^{\frac{1}{2}} + E^{\frac{-1}{2}})$.
10. Find the missing term in the following data.

| | | | | | |
|---|---|---|---|---|---|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 1 | 3 | 9 | - | 81 |

9-3-2016

## 2.1 Differential Calculus

DSC-1A BS:104

Theory: 4 credits and Practicals: 1 credits
Theory: 4 hours /week and Practicals: 2 hours /week

**Objective:** The course is aimed at exposing the students to some basic notions in differential calculus.
**Outcome:** By the time students completes the course they realize wide ranging applications of the subject.

**Unit- I**

Successive differentiation- Expansions of Functions- Mean value theorems

**Unit- II**

Indeterminate forms - Curvature and Evolutes

**Unit- III**

Partial differentiation - Homogeneous functions- Total derivative.

**Unit- IV**

Maxima and Minima of functions of two variables - Lagrange's Method of multipliers - Asymptotes- Envelopes.

**Text:**

- Shanti Narayan and Mittal, *Differential Calculus*

**References:**


- William Anthony Granville, Percey F Smith and William Raymond Longley; *Elements of the differential and integral calculus*
- Joseph Edwards , *Differential calculus for beginners*
- Smith and Minton, *Calculus*
- Elis Pine, *How to Enjoy Calculus*
- Hari Kishan, *Differential Calculus*

### 2.1.1 Practicals Question Bank

**Differential Calculus**

**Unit-I**

1. If $u = \tan^{-1} x$ prove that
$$(1+x^2)\frac{d^2u}{dx^2} + 2x\frac{du}{dx} = 0$$
and hence determine the values of the derivatives of $u$ when $x = 0$.

2. If $y = \sin(m \sin^{-1} x)$ show that
$$(1-x^2)y_{n+2} = (2n+1)xy_{n+1} + (n^2 - m^2)y_n$$
and find $y_n(0)$

3. If $U_n$ denotes the $nth$ derivative of $\frac{Lx+M}{x^2-2Bx+C}$., prove
$$\frac{x^2-2Bx+C}{(n+1)(n+2)}U_{n+2} + \frac{2(x-B)}{n+1}U_{n+1} + U_n = 0$$

4. If $y = x^2 e^x$, then
$$\frac{d^n y}{dx^n} = \frac{1}{2}n(n-1)\frac{d^2y}{dx^2} - n(n-2)\frac{dy}{dx} + \frac{1}{2}(n-1)(n-2)y.$$

5. Determine the intervals in which the function
$$(x^4 + 6x^3 + 17x^2 + 32x + 32)e^{-x}$$
is increasing or decreasing.

6. Separate the intervals in which the function
$$\frac{(x^2+x+1)}{(x^2-x+1)}$$
is increasing or decreasing.

7. Show that if $x > 0$,

   *(i)* $x - \frac{x^2}{2} < \log(1+x) < x - \frac{x^2}{2(1+x)}$.

   *(ii)* $x - \frac{x^2}{2} + \frac{x^3}{3(1+x)} < \log(1+x) < x - \frac{x^2}{2} + \frac{x^3}{3}$.

8. Prove that
$$e^{ax}\sin bx = bx + abx^2 + \frac{3a^2b - b^3}{3!}x^3 + ...... + \frac{(a^2+b^2)^{\frac{1}{2}n}}{n!}x^n \sin(n \tan^{-1}\frac{b}{a}) + .....$$

9. Show that
$$\cos^2 x = 1 - x^2 + \frac{1}{3}x^4 - \frac{2}{45}x^6........$$

10. Show that

$$e^{m\tan^{-1}x} = 1 + mx + \frac{m^2}{2!}x^2 + \frac{m(m^2-2)}{3!}x^3 + \frac{m^2(m^2-8)}{4!}x^4 + .......$$

## Unit-II

11. Find the radius of curvature at any point on the curves

*(i)* $y = c\cosh(\frac{x}{c})$. (Catenary)

*(ii)* $x = a(\cos t + t\sin t), y = a(\sin t - t\cos t)$.

*(iii)* $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$. (Astroid)

*(iv)* $x = \frac{(a\cos t)}{t}, y = \frac{(a\sin t)}{t}$.

12. Show that for the curve

$$x = a\cos\theta(1+\sin\theta), y = a\sin\theta(1+\cos\theta),$$

the radius of curvature is $a$ at the point for which the value of the parameter is $\frac{-\pi}{4}$.

13. Prove that the radius of curvature at the point $(-2a, 2a)$ on the curve $x^2y = a(x^2+y^2)$ is $-2a$.

14. Show that the radii of curvature of the curve

$$x = ae^{\theta}(\sin\theta - \cos\theta), y = ae^{\theta}(\sin\theta + \cos\theta)$$

and its evolute at corresponding points are equal.

15. Show that the whole length of the evolute of the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

is $4(\frac{a^2}{b} - \frac{b^2}{a})$.

16. Show that the whole length of the evolute of the astroid

$$x = a\cos^3\theta, y = a\sin^3\theta$$

is $12a$

17. Evaluate the following:

*(i)* $\lim_{x\to 0} \frac{xe^x - \log(1+x)}{x^2}$

*(ii)* $\lim_{x\to 0} \frac{x\cos x - \log(1+x)}{x^2}$

*(iii)* $\lim_{x\to 0} \frac{e^x\sin x - x - x^2}{x^2 + x\log(1-x)}$

*(iv)* $\lim_{x\to 0}\{\frac{1}{x} - \frac{1}{x^2}\log(1+x)\}$

18. If the limit of

$$\frac{\sin 2x + a\sin x}{x^8}$$

as $x$ tends to zero, be finite, find the value of $a$ and the limit.

19. Determine the limits of the following functions:

*(i)* $x\log(\tan x), (x \to 0)$ *(ii)* $x\tan(\pi/2 - x), (x \to 0)$

*(iii)* $(a-x)\tan(\pi x/2a), (x \to 0)$

20. Determine the limits of the following functions:

*(i)* $\frac{e^x - e^{-x} - x}{x^2 \sin x}, (x \to 0)$ *(ii)* $\frac{\log x}{x^3}, (x \to \infty)$

*(iii)* $\frac{1 + x\cos x - \cosh x - \log(1+x)}{\tan x - x}, (x \to 0)$ *(iv)* $\frac{\log(1+x)\log(1-x) - \log(1-x^2)}{x^4}, (x \to 0)$

## Unit-III

21. If $z = xyf(x/y)$ then show that

$$x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = 2z$$

22. If $z(x+y) = x^2 + y^2$ then show that

$$\left(\frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)^2 = 4\left(1 - \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)$$

23. If $z = 3xy - y^3 + (y^2 - 2x)^{\frac{3}{2}}$, verify that

$$\frac{\partial^2 z}{\partial x \partial y} = \frac{\partial^2 z}{\partial y \partial x} \quad and \quad \frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial y^2} = \left(\frac{\partial^2 z}{\partial x \partial y}\right)^2$$

24. If $z = f(x + ay) + \varphi(x - ay)$ , prove that

$$\frac{\partial^2 z}{\partial y^2} = a^2\frac{\partial^2 z}{\partial x^2}.$$

25. If $u = \tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, find

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2}.$$

26. If $f(x,y) = 0$, $\varphi(y,z) = 0$, show that

$$\frac{\partial f}{\partial y}.\frac{\partial \varphi}{\partial z}.\frac{dz}{dx} = \frac{\partial f}{\partial x}.\frac{\partial \varphi}{\partial y}.$$

27. If $x\sqrt{1-y^2} + y\sqrt{1-x^2} = a$, show that

$$\frac{d^2y}{dx^2} = \frac{a}{(1-x^2)^{\frac{3}{2}}}.$$

28. Given that $f(x,y) \equiv x^3 + y^3 - 3axy = 0$, show that

$$\frac{d^2y}{dx^2}.\frac{d^2x}{dy^2} = \frac{4a^6}{xy(xy - 2a^2)^3}.$$

*(i)* $a + b = c$. *(ii)* $a^2 + b^2 = c^2$. *(iii)* $ab = c^2$.

$c$ is a constant.

38. Find the asymptotes of

$$x^3 + 4x^2y + 4xy^2 + 5x^2 + 15xy + 10y^2 - 2y + 1 = 0.$$

39. Find the asymptotes of

$$y^3 + x^3 + y^2 + x^2 - x + 1 = 0.$$

40. Find the asymptotes of the following curves

*(i)* $xy(x + y) = a(x^2 - a^2)$

*(ii)* $y^3 - x^3 + y^2 + x^2 + y - x + 1 = 0$.

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## 2.2 Differential Equations

DSC-1B

BS:204

Theory: 4 credits and Practicals: 1 credits
Theory: 4 hours /week and Practicals: 2 hours /week

**Objective:** The main aim of this course is to introduce the students to the techniques of solving differential equations and to train to apply their skills in solving some of the problems of engineering and science.
**Outcome:** After learning the course the students will be equipped with the various tools to solve few types differential equations that arise in several branches of science.

### Unit- I

Differential Equations of first order and first degree: Exact differential equations - Integrating Factors - Change in variables - Total Differential Equations - Simultaneous Total Differential Equations - Equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Differential Equations first order but not of first degree: Equations Solvable for $y$ - Equations Solvable for $x$ - Equations that do not contain $x$ (or$y$)- Clairaut's equation.

### Unit- II

Higher order linear differential equations: Solution of homogeneous linear differential equations with constant coefficients - Solution of non-homogeneous differential equations $P(D)y = Q(x)$ with constant coefficients by means of polynomial operators when $Q(x) = be^{ax}, b\sin ax/b\cos ax, bx^k, Ve^{ax}$.

### Unit- III

Method of undetermined coefficients - Method of variation of parameters - Linear differential equations with non constant coefficients - The Cauchy - Euler Equation.

### Unit- IV

Partial Differential equations- Formation and solution- Equations easily integrable - Linear equations of first order - Non linear equations of first order - Charpit's method - Homogeneous linear partial differential equations with constant coefficient - Non homogeneous linear partial differential equations - Separation of variables.

**Text:**

- Zafar Ahsan,*Differential Equations and Their Applications*

References:


- Frank Ayres Jr, *Theory and Problems of Differential Equations.*
- Ford, L.R ; *Differential Equations.*
- Daniel Murray, *Differential Equations.*
- S. Balachandra Rao, *Differential Equations with Applications and Programs.*
- Stuart P Hastings, J Bryce McLead; *Classical Methods in Ordinary Differential Equations.*


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### 2.2.1 Practicals Question Bank

## Differential Equations

### Unit-I

Solve the following differential equations:

1. $y' = \sin(x + y) + \cos(x + y)$
2. $xdy - ydx = a(x^2 + y^2)dy$
3. $x^2ydx - (x^3 + y^3)dy = 0$
4. $(y + z)dx + (x + z)dy + (x + y)dz = 0$
5. $y \sin 2xdx - (1 + y^2 + \cos^2 x)dy = 0$
6. $y + px = p^2x^4$
7. $yp^2 + (x - y)p - x = 0$
8. $\frac{dx}{y-zx} = \frac{dy}{yz+x} = \frac{dz}{(x^2+y^2)}$
9. $\frac{dx}{x(y^2-z^2)} = \frac{dy}{y(z^2-x^2)} = \frac{dz}{z(x^2-y^2)}$
10. Use the transformation $x^2 = u$ and $y^2 = v$ to solve the equation $axyp^2 + (x^2 - ay^2 - b)p - xy = 0$

### Unit-II

Solve the following differential equations:

11. $D^2y + (a + b)Dy + aby = 0$
12. $D^3y - D^2y - Dy - 2y = 0$
13. $D^3y + Dy = x^2 + 2x$
14. $y'' + 3y' + 2y = 2(e^{-2x} + x^2)$
15. $y^{(5)} - 2y''' + y' = 2x + \sin x + \cos x$
16. $(D^2 + 1)(D^2 + 4)y = \cos \frac{x}{2} \cos \frac{3x}{2}$
17. $(D^2 + 1)y = \cos x + xe^{2x} + e^x \sin x$
18. $y'' + 3y' + 2y = 12e^x$
19. $y'' - y = \cos x$
20. $4y'' - 5y' = x^2e^x$

## Unit-III

Solve the following differential equations:

21. $y'' + 3y' + 2y = xe^{x}$

22. $y'' + 3y' + 2y = \sin x$

23. $y'' + y' + y = x^2$

24. $y'' + 2y' + y = x^2 e^{-x}$

25. $x^2 y'' - xy' + y = 2\log x$

26. $x^4 y''' + 2x^3 y'' - x^2 y' + xy = 1$

27. $x^2 y'' - xy' + 2y = x\log x$

28. $x^2 y'' - xy' + 2y = x$

Use the reduction of order method to solve the following homogeneous equation whose one of the solution is given:

29. $y'' - \frac{2}{x}y' + \frac{2}{x^2}y = 0, y_1 = x$

30. $(2x^2 + 1)y'' - 4xy' + 4y = 0, y_1 = x$

## Unit-IV

31. Form the partial differential equation, by eliminating the arbitrary constants from $z = (x^2 + a)(y^2 + b)$.

32. Find the differential equation of the family of all planes whose members are all at a constant distance r from the origin.

33. Form the differential equation by eliminating arbitrary function F from $F(x^2 + y^2, z - xy) = 0$.

Solve the following differential equations:

34. $x^2(y - z)p + y^2(z - x)q = z^2(x - y)$

35. $x(z^2 - y^2)p + y(x^2 - z^2)q = z(y^2 - x^2)$

36. $(p^2 - q^2)z = x - y$

37. $z = px + qy + p^2q^2$

38. $z^2 = pqxy$

39. $z^2(p^2 + q^2) = x^2 + y^2$

40. $r + s - 6t = \cos(2x + y)$

## 2.5 Real Analysis

DSC-1C | BS:304

Theory: 4 credits and Practicals: 1 credits
Theory: 4 hours /week and Practicals: 2 hours /week

**Objective:** The course is aimed at exposing the students to the foundations of analysis which will be useful in understanding various physical phenomena.
**Outcome:** After the completion of the course students will be in a position to appreciate beauty and applicability of the course.

### Unit- I

Sequences: Limits of Sequences- A Discussion about Proofs-Limit Theorems for Sequences-Monotone Sequences and Cauchy Sequences.

### Unit- II

Subsequences-Lim sup's and Lim inf's-Series-Alternating Series and Integral Tests .

### Unit- III

Sequences and Series of Functions: Power Series-Uniform Convergence-More on Uniform Convergence-Differentiation and Integration of Power Series (Theorems in this section without Proofs).

### Unit- IV

Integration : The Riemann Integral - Properties of Riemann Integral-Fundamental Theorem of Calculus.

**Text:**

- Kenneth A Ross, *Elementary Analysis- The Theory of Calculus*

**References:**


- William F. Trench, *Introduction to Real Analysis*
- Lee Larson , *Introduction to Real Analysis I*
- Shanti Narayan and Mittal. *Mathematical Analysis*
- Brian S. Thomson, Judith B. Bruckner. Andrew M. Bruckner; *Elementary Real analysis*
- Sudhir R., Ghorpade. Balmohan V. Limaye: *A Course in Calculus and Real Analysis*


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### 2.5.1 Practicals Question Bank

## Real Analysis

### Unit-I

1. For each sequence below, determine whether it converges and, if it converges, give its limit. No proofs are required.

   (a) $a_n = \frac{n}{n+1}$
   (b) $b_n = \frac{n^2+3}{n^2-3}$
   (c) $c_n = 2^{-n}$
   (d) $t_n = 1 + \frac{2}{n}$
   (e) $x_n = 73 + (-1)^n$
   (f) $s_n = (2)^{\frac{1}{n}}$

2. Determine the limits of the following sequences, and then prove your claims.

   (a) $a_n = \frac{n}{n^2+1}$
   (b) $b_n = \frac{7n-19}{3n+7}$
   (c) $c_n = \frac{4n+3}{7n-5}$
   (d) $d_n = \frac{2n+4}{5n+2}$
   (e) $s_n = \frac{1}{n} \sin n$

3. Suppose $\lim a_n = a$, $\lim b_n = b$, and $s_n = \frac{a_n^3+4a_n}{b_n^2+1}$. Prove $\lim s_n = \frac{a^3+4a}{b^2+1}$ carefully, using the limit theorems.

4. Let $x_1 = 1$ and $x_{n+1} = 3x_n^2$ for $n \geq 1$.

   (a) Show if $a = \lim x_n$, then $a = \frac{1}{3}$ or $a = 0$.
   (b) Does $\lim x_n$ exist? Explain.
   (c) Discuss the apparent contradiction between parts (a) and (b).

5. Which of the following sequences are increasing? decreasing? bounded?

   (a) $\frac{1}{n}$
   (b) $\frac{(-1)^n}{n^2}$
   (c) $n^5$
   (d) $\sin(\frac{n\pi}{7})$
   (e) $(-2)^n$
   (f) $\frac{n}{3^n}$

6. Let $(s_n)$ be a sequence such that $|s_{n+1} - s_n| < 2^{-n}$ for all $n \in \mathbb{N}$. Prove $(s_n)$ is a Cauchy sequence and hence a convergent sequence.

7. Let $(s_n)$ be an increasing sequence of positive numbers and define $\sigma_n = \frac{1}{n}(s_1 + s_2 + ... + s_n)$. Prove $(\sigma_n)$ is an increasing sequence.

8. Let $t_1 = 1$ and $t_{n+1} = [1 - \frac{1}{4n^2}] t_n$ for $n \geq 1$.

   (a) Show $\lim t_n$ exists.
   (b) What do you think $\lim t_n$ is?

9. Let $t_1 = 1$ and $t_{n+1} = [1 - \frac{1}{(n+1)^2}].t_n$ for all $n \geq 1$.

   (a) Show $\lim t_n$ exists.

   (b) What do you think $\lim t_n$ is?

   (c) Use induction to show $t_n = \frac{n+1}{2n}$.

   (d) Repeat part (b).

10. Let $s_1 = 1$ and $s_{n+1} = \frac{1}{3}(s_n + 1)$ for $n \geq 1$.

   (a) Find $s_2$, $s_3$ and $s_4$.

   (b) Use induction to show $s_n > \frac{1}{2}$ for all n.

   (c) Show $(s_n)$ is a decreasing sequence.

   (d) Show $\lim s_n$ exists and find $\lim s_n$.

## Unit-II

11. Let $a_n = 3 + 2(-1)^n$ for $n \in \mathbb{N}$.

   (a) List the first eight terms of the sequence $(a_n)$.

   (b) Give a subsequence that is constant [takes a single value]. Specify the selection function $\sigma$.

12. Consider the sequences defined as follows:

   $a_n = (-1)^n$, $b_n = \frac{1}{n}$. $c_n = n^2$, $d_n = \frac{6n+4}{7n-3}$.

   (a) For each sequence, give an example of a monotone subsequence.

   (b) For each sequence, give its set of subsequential limits.

   (c) For each sequence, give its lim sup and lim inf.

   (d) Which of the sequences converges? diverges to $+\infty$? diverges to $-\infty$?

   (e) Which of the sequences is bounded?

13. Prove $\limsup |s_n| = 0$ if and only if $\lim s_n = 0$.

14. Let $(s_n)$ and $(t_n)$ be the following sequences that repeat in cycles of four:

$$(s_n) = (0, 1, 2, 1, 0, 1, 2, 1, 0, 1, 2, 1, 0, 1, 2, 1, 0, ...)$$

$$(t_n) = (2, 1, 1, 0, 2, 1, 1, 0, 2, 1, 1, 0, 2, 1, 1, 0, 2, ...)$$

   Find

   (a) $\liminf s_n + \liminf t_n$.

   (b) $\liminf(s_n + t_n)$.

   (c) $\liminf s_n + \limsup t_n$.

   (d) $\limsup(s_n + t_n)$.

## 2.8 Algebra

DSC-1D BS:404

Theory: 4 credits and Practicals: 1 credits
Theory: 4 hours /week and Practicals: 2 hours /week

**Objective:** The course is aimed at exposing the students to learn some basic algebraic structures like groups, rings etc.

**Outcome:** On successful completion of the course students will be able to recognize algebraic structures that arise in matrix algebra, linear algebra and will be able to apply the skills learnt in understanding various such subjects.

### Unit- I

Groups: Definition and Examples of Groups- Elementary Properties of Groups-Finite Groups; Subgroups -Terminology and Notation -Subgroup Tests - Examples of Subgroups Cyclic Groups: Properties of Cyclic Groups - Classification of Subgroups Cyclic Groups-Permutation Groups: Definition and Notation -Cycle Notation-Properties of Permutations -A Check Digit Scheme Based on $D_5$.

### Unit- II

Isomorphisms ; Motivation- Definition and Examples -Cayley's Theorem Properties of Isomorphisms -Automorphisms-Cosets and Lagrange's Theorem Properties of Cosets 138 - Lagrange's Theorem and Consequences-An Application of Cosets to Permutation Groups -The Rotation Group of a Cube and a Soccer Ball -Normal Subgroups and Factor Groups ; Normal Subgroups-Factor Groups -Applications of Factor Groups -Group Homomorphisms - Definition and Examples -Properties of Homomorphisms -The First Isomorphism Theorem.

### Unit- III

Introduction to Rings: Motivation and Definition -Examples of Rings -Properties of Rings -Subrings -Integral Domains : Definition and Examples -Characteristics of a Ring -Ideals and Factor Rings; Ideals -Factor Rings -Prime Ideals and Maximal Ideals.

### Unit- IV

Ring Homomorphisms: Definition and Examples-Properties of Ring- Homomorphisms -The Field of Quotients Polynomial Rings: Notation and Terminology.

**Text:**

- Joseph A Gallian, *Contemporary Abstract algebra (9th edition)*

References:


- Bhattacharya, P.B Jain, S.K.; and Nagpaul, S.R, *Basic Abstract Algebra*
- Fraleigh, J.B, *A First Course in Abstract Algebra.*
- Herstein, I.N, *Topics in Algebra*
- Robert B. Ash, *Basic Abstract Algebra*
- I Martin Isaacs, *Finite Group Theory*
- Joseph J Rotman, *Advanced Modern Algebra*


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### 2.8.1 Practicals Question Bank

## Algebra
### Unit-I

1. Show that $\{1, 2, 3\}$ under multiplication modulo 4 is not a group but that $\{1, 2, 3, 4\}$ under multiplication modulo 5 is a group.

2. Let G be a group with the property that for any x, y, z in the group, $xy = zx$ implies $y = z$. Prove that G is Abelian.

3. Prove that the set of all $3 \times 3$ matrices with real entries of the form

$$\begin{pmatrix} 1 & a & b \\ 0 & 1 & c \\ 0 & 0 & 1 \end{pmatrix}$$

   is a group under multiplication.

4. Let G be the group of polynomials under addition with coefficients from $Z_{10}$. Find the orders of $f(x) = 7x^2 + 5x + 4, g(x) = 4x^2 + 8x + 6$, and $f(x) + g(x)$

5. If $a$ is an element of a group G and $|a| = 7$, show that $a$ is the cube of some element of G.

6. Suppose that $\langle a \rangle, \langle b \rangle$ and $\langle c \rangle$ are cyclic groups of orders 6, 8, and 20, respectively. Find all generators of $\langle a \rangle, \langle b \rangle$, and $\langle c \rangle$.

7. How many subgroups does $Z_{20}$ have? List a generator for each of these subgroups.

8. Consider the set $\{4, 8, 12, 16\}$. Show that this set is a group under multiplication modulo 20 by constructing its Cayley table. What is the identity element? Is the group cyclic? If so, find all of its generators.

9. Prove that a group of order 4 cannot have a subgroup of order 3.

10. Determine whether the following permutations are even or odd.
    a. (135)
    b. (1356)
    c. (13567)
    d. (12)(134)(152)
    e. (1243)(3521).

### Unit-II

11. Show that the mapping $a \longrightarrow \log_{10} a$ is an isomorphism from $R^+$ under multiplication to $R$ under addition.

12. Show that the mapping $f(a + bi) = a - bi$ is an automorphism of the group of complex numbers under addition.

13. Find all of the left cosets of $\{1, 11\}$ in $U(30)$.

14. Let $C^*$ be the group of nonzero complex numbers under multiplication and let $H = \{a+bi \in C^*/a^2+b^2=1\}$. Give a geometric description of the coset $(3+4i)H$. Give a geometric description of the coset $(c+di)H$.

15. Let $H = \left\{ \begin{pmatrix} a & b \\ 0 & d \end{pmatrix} /a, b, d \in R, ad \neq 0 \right\}$. Is $H$ a normal subgroup of $GL(2,R)$?

16. What is the order of the factor group $\frac{Z_{60}}{\langle 5 \rangle}$?

17. Let $G = U(16), H = \{1, 15\}$, and $K = \{1, 9\}$. Are $H$ and $K$ isomorphic? Are $G/H$ and $G/K$ isomorphic?

18. Prove that the mapping from $R$ under addition to $GL(2,R)$ that takes $x$ to

$$\begin{bmatrix} cosx & sinx \\ -sinx & cosx \end{bmatrix}$$

is a group homomorphism. What is the kernel of the homomorphism?

19. Suppose that f is a homomorphism from $Z30$ to $Z30$ and $Ker f = \{0, 10, 20\}$. If $f(23) = 9$, determine all elements that map to 9.

20. How many Abelian groups (up to isomorphism) are there
a. of order 6?
b. of order 15?
c. of order 42?
d. of order $pq$, where $p$ and $q$ are distinct primes?
e. of order $pqr$, where $p$, $q$, and $r$ are distinct primes?

## Unit-III

21. Let $M_2(Z)$ be the ring of all $2 \times 2$ matrices over the integers and let $R = \left\{ \begin{pmatrix} a & a \\ b & b \end{pmatrix} /a, b \in Z \right\}$ Prove or disprove that R is a subring of $M_2(Z)$.

22. Suppose that $a$ and $b$ belong to a commutative ring $R$ with unity. If $a$ is a unit of $R$ and $b^2 = 0$, show that $a+b$ is a unit of $R$.

23. Let $n$ be an integer greater than 1. In a ring in which $x^n = x$ for all $x$, show that $ab = 0$ implies $ba = 0$.

24. List all zero-divisors in $Z_{20}$. Can you see a relationship between the zero-divisors of $Z_{20}$ and the units of $Z_{20}$?

25. Let $a$ belong to a ring $R$ with unity and suppose that $a^n = 0$ for some positive integer $n$. (Such an element is called nilpotent.) Prove that $1-a$ has a multiplicative inverse in $R$.

26. Let $d$ be an integer. Prove that $Z[\sqrt{d}] = \{a + b\sqrt{d}/a, b \in Z\}$ is an integral domain.

27. Show that $Z_n$ has a nonzero nilpotent element if and only if $n$ is divisible by the square of some prime.

28. Find all units, zero-divisors, idempotents, and nilpotent elements in $Z_3 \bigoplus Z_6$.

29. Find all maximal ideals in
   a. $Z_8$.
   b. $Z_{10}$.
   c. $Z_{12}$.
   d. $Z_n$.

30. Show that $R[x]/\langle x^2+1\rangle$ is a field.

Unit-IV

31. Prove that every ring homomorphism $f$ from $Z_n$ to itself has the form $f(x) = ax$, where $a^2 = a$.

32. Prove that a ring homomorphism carries an idempotent to an idempotent.

33. In $Z$, let $A = \langle 2\rangle$ and $B = \langle 8\rangle$. Show that the group $A/B$ is isomorphic to the group $Z_4$ but that the ring $A/B$ is not ring-isomorphic to the ring $Z_4$.

34. Show that the number $9,897,654,527,609,805$ is divisible by 99.

35. Show that no integer of the form $111,111,111,....111$ is prime.

36. Let $f(x) = 4x^3+2x^2+x+3$ and $g(x) = 3x^4+3x^3+3x^2+x+4$, where $f(x), g(x) \in Z_5[x]$. Compute $f(x)+g(x)$ and $f(x).g(x)$.

37. Let $f(x) = 5x^4+3x^3+1$ and $g(x) = 3x^2+2x+1$ in $Z_7[x]$.Determine the quotient and remainder upon dividing $f(x)$ by $g(x)$.

38. Let $f(x)$ belong to $Z_p[x]$. Prove that if $f(b) = 0$, then $f(b^p) = 0$.

39. Determine which of the polynomials below is (are) irreducible over Q.
   a. $x^5+9x^4+12x^2+6$
   b. $x^4+x+1$
   c. $x^4+3x^2+3$
   d. $x^5+5x^2+1$
   e. $(5/2)x^5+(9/2)x^4+15x^3+(3/7)x^2+6x+3/14$.

40. Show that $x^2+x+4$ is irreducible over $Z_{11}$.

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GOVERNMENT DEGREE COLLEGE FOR WOMEN

BEGUMPET, HYDERABAD

Max Marks:15M AUTONOMOUS[CBCS]

Time :1/2 hr NAAC ACCREDITED "B"

Internal Assessment Test Model Paper

Semester: VI

Subject: Mathematics, Paper VII

## SECTION –A

**Answer any five.** [5X2=10 M]

1. State Bessel's inequality.
2. State Parsvel's identity.
3. State Cauchy's integral formula.
4. State parallelogram law.
5. State Triangle inequality.
6. If (1,2,3) find unit vector along .
7. If u,v are Orthogonal unit vectors find d(u,v).
8. Define Orthonormal basis.

## SECTION-B

**Answer any one.** [5x1=5M]

1. State and prove Cauchy's theorem.

   [OR]

2. State and prove Schwartz inequality.

GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)

BEGUMPET, HYDERABAD -16

B.Sc MATHEMATICS Semester III &IV

Panel of Examiners for Paper III&IV

| S.NO | Name | Designation | Teaching Experience | Address |
|---|---|---|---|---|
| 1 | Dr.G.Kamala | Associate Professor | 25 Yrs | Department of Mathematics,Osmania University. Mobile :9848020397 |
| 2 | Dr.Vijaya Lakshmi | Associate Professor | 23 Yrs | Department of Mathematics,Loyola Academy ,Hyderabad Mobile :9849970835 |
| 3 | Mrs.P.Rekha | Assistant Professor | 15 Yrs | St.Francis College for Women ,Begumpet,Hyderabad. Mobile :9000603572 |
| 4 | Mrs.Sai.Lakshmi | Assistant Professor | 10 Yrs | DBPM College,Secunderabad. Mobile :9248164560 |
| 5 | Dr.Lalitha | Assistant Professor | 23 Yrs | St.Francis College for Women Mobile:9908671217 |

# GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)

## BEGUMPET, HYDERABAD – 16

## MATHEMATICS PAPER – V (Semester – V)

## LINEAR ALGEBRA AND COMPLEX ANALYSIS

Syllabus

**Linear Algebra**

**Unit – I: (15 Hours)**

Vector spaces, General properties of vector spaces, Vector subspaces, Algebra of subspaces, linear combination of vectors. Linear span, linear sum of two subspaces, Linear independence and dependence of vectors, Basis of vector space, Finite dimensional vector spaces, Dimension of a vector space, Dimension of a subspace.

**Unit – II: (10 Hours)**

Linear transformations, linear operators, Range and null space of linear transformation, Rank and nullity of linear transformations, Linear transformations as vectors, Product of linear transformations, Invertible linear transformation.

**Prescribed text book:**

Linear Algebra by V. Krishna Murthy and others

**Reference Books:**

1. Linear Algebra by Kenneth Hoffman and Ray Kunze, Pearson Education (low priced edition), New Delhi
2. Linear Algebra by Stephen H. Friedberg et al Prentice Hall of India Pvt. Ltd. 4th edition 2007
3. Linear Algebra by J.N.Sharma and A.R.Vasista, Krishna Prakasham Mandir, Meerut-250002.

**Complex Analysis**

**Unit – III: (10 Hours)**

Representation of complex number in polar form, Roots of complex numbers, Exponential functions, Hyperbolic functions, Trignometric functions, Inverse hyperbolic functions, Logarithmic functions and their properties.

**Unit – IV: (10 Hours)**

Limit of a complex function, Continuity of a complex function, Derivative of a complex function, Analytic functions, Entire functions, Cauchy Riemann equations, Applications

**Prescribed text book:**

Complex Analysis by JN Sharma

**Reference Books:**

1. Complex Variables and Applications by R.V.Churchill.
2. Higher Engineering Mathematics by B.S Grewal

9-3-2016

GOVERNMENT DEGREE COLLEGE FOR WOMEN
BEGUMPET, HYDERABAD.
AUTONOMOUS
NAAC ACCREDITED "B"
CBCS
MODEL PAPER
SEMESTER-V

Max Marks: 75
Time: $2\frac{1}{2}$hr.

Linear Algebra and Complex Analysis — Paper -V

## SECTION-A

**Answer All Questions.** **4×10=40 Marks**

1. a) State and prove necessary and sufficient condition for a non empty subset to be a sub space.

Or

b) State and prove dimensional formula.

2. a) State and prove Rank-Nullity theorem.

b) If $\{e_1, e_2, e_3\}$ is a standard basis of $V_3(R)$ .Show that $T:R^3 \to R^3$ is invertible and hence find $T^{-1}$.

3. a) i. Find all values of $(1+i)^{\frac{1}{4}}$ .

ii. Prove that $sinh^{-1}z = \log(z+\sqrt{z^2+1})$.

b) Find all the common roots to the equations $x^4+1=0$ and $x^6 - i = 0$.

4. a) Find the analytic function whose real part is $x^3 - 3xy^2+3x^2-3y^2+1$

b) Show that $f(z) = xy^2(x+iy)$ ,$z\neq 0$ & $f(z)=0$ at $z=0$ is not analytic even though Cauchy Riemann equations are satisfied.

## SECTION-B

**Answer any Five Questions.** **5× 5=25Marks**

5. Determine whether { (1,1,-1),(2,-3,5),(-2,1,4) of $R^3$ is linearly independent or dependent

.

6. Show that W={(x,y,z)/x-3y+4z=0} is a subspace of $R^3(R)$.
7. Show that $T:R^3 \to R^3$ given by T(a,b,c)=(a-b,b-a,-a) is linear.
8. If $T:U\to V$ is a linear transformation then null space of T is a subspace of U.
9. Solve the equation $z^6+1=0$.
10. Find the principal and general value of $i^i$.
11. Show that $f(z)= z+2\bar{z}$ is not analytic any where in complete plane.
12. Find the harmonic conjugate of cosxcoshy.

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Head
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PROFESSOR,
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OSMANIA UNIVERSITY,

## SECTION-C

**Answer any Five Questions.** **$5\times 2 = 10$ Marks**

13. Define Basis.
14. If W is spanned by {(1,2,-2,1),(1,3,-1,4),(2,1,-7,-7)} then find dimW.
15. Define Rank and Nullity of a linear transformation.
16. Define singular and non singular transformations.
17. Find the real and imaginary parts of sinz,cosz.
18. Find the roots of cosz=2
19. State necessary and sufficient conditions for a function f(z) to be analytic.
20. Define Harmonic function.

Why this value is not equal to $3^3$.Explain.

11. Explain errors in Lagrange's interpolation.
12. Find the equation y=f(x) of least degree and passing through the points (-1,-21);(1,15);(2,12);(3,3).

## SECTION –C

**Answer any Five Questions.**

**5×2=10Marks**

13. Define absolute and relative errors.
14. Round the numbers 38.46235 and 0.70029 to four significant figures.
15. Define Algebraic and transcendental equations.
16. Write the formula for D in Muller's method.
17. Write the Stirling's formula.
18. Evalute $\Delta log f(x)$.
19. Write Lagrange's interpolation formula.
20. Contruct divided difference table to the data

| | | | |
|---|---|---|---|
| 2 | 4 | 9 | 10 |
| 4 | 56 | 711 | 980 |

# GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)

## BEGUMPET, HYDERABAD – 16

## MATHEMATICS PAPER - VI (Semester – VI)

## LINEAR ALGEBRA AND COMPLEX ANALYSIS

**Linear Algebra**

**Unit – I: (10 Hours)**

The adjoint or transpose of a linear transformation, Sylvester's law of nullity, characteristic values and characteristic vectors, Cayley- Hamilton theorem, Diagonalizable operators.

**Unit – II: (15 Hours)**

Inner product spaces, Euclidean and unitary spaces, Norm or length of a vector, Schwartz inequality, Orthogonality, Orthonormal set, complete orthonormal set, Gram - Schmidt orthogonalisation process.

**Prescribed text book:**

Linear Algebra by V. Krishna Murthy and others

**Reference Books:**

1. Linear Algebra by Kenneth Hoffman and Ray Kunze, Pearson Education (low priced edition), New Delhi
2. Linear Algebra by Stephen H. Friedberg et al Prentice Hall of India Pvt. Ltd. 4th edition 2007
3. Linear Algebra by J.N.Sharma and A.R.Vasista, Krishna Prakasham Mandir, Meerut-250002.

**Complex Analysis**

**Unit – III: (10 Hours)**

Harmonic functions, Methods of finding Harmonic conjugates, Complex Integration, Cauchy theorem, Cauchy Integral formula.

**Unit – IV: (10 Hours)**

Taylor series, Laurent Series, Nature of singularities and Methods of finding residues, Cauchy residue theorem and applications.

**Prescribed text book:**

Complex Analysis by JN Sharma

**Reference Books:**

1. Complex Variables and Applications by R.V.Churchill.
2. Higher Engineering Mathematics by B.S Grewal

M. Ren 4-3-2016 Head Department of Mathematics

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Department of Mathematics OSMANIA UNIVERSITY HYDERABAD-500 007

**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)**

**BEGUMPET ,HYDERABAD**

**MATHEMATICS PAPER VI (SEMESTER VI)**

**MODEL PAPER (CBCS)**

**LINEAR ALGEBRA AND COMPLEX ANALYSIS**

**TIME: 2 ½ Hrs** **MAX MARKS:75**

## Section – A

**(4x10=40 Marks)**

**Answer ALL questions.**

1. a).Find all eigen values and eigen vectors of the matrix $\begin{pmatrix} 3 & 2 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 3 \end{pmatrix}$

(or)

b).State and prove Cayley Hamilton theorem.

2. a).State and prove Bessel's inequality.

(or)

b).State and prove Gram-Schmidt orthonormalization process.

3. a).State and prove Cauchy's integral formula for derivaties .

(or)

b).Evaluate (i) $\int_{|z|=1} z^2 e^{1/z} dz.$ (ii)$\oint_{|z-i|=2} \frac{e^z}{z^2+4} dz$

4. a).Determine the poles of f(z)= $\frac{z^2}{(z-1)^2(z+2)}$ and residue at each pole.Hence deduce $\int_{|z|=1} f(z)dz$

(or)

b).Evaluate $\int_C \frac{(2z-1)dz}{z(z+2)(2z+1)}$ with C;|z|=1.

## Section-B

**(5x5=25 marks)**

**Answer any FIVE questions.**

M. Ram 9-3-2016

Chairman, Board of Studies in Mathematics, Osmania University, Hyderabad-500007.

Head Department of Mathematics

5. Prove that the matrix $A=\begin{bmatrix}1 & 2\\0 & 1\end{bmatrix}$ is not diagonalizable.

6. Show that the characteristic equation of the complex matrix $A=\begin{bmatrix}0 & 0 & c\\1 & 0 & b\\0 & 1 & a\end{bmatrix}$ is

$x^3-ax^2-bx-c=0$.

7. State and prove Schwartz inequality.

8. Prove that $\alpha$ and $\beta$ in a real inner product space are orthogonal iff

$||\alpha+\beta||^2=||\alpha||^2+||\beta||^2$.

9. Evaluate $\int_C \frac{z^2+1}{z(2z+1)}dz$ where C;|z|=1.

10. Evaluate $\int_C \frac{e^{2z}}{(z+1)^4}dz$ where C;|z-1|=3.

11. Find the nature of singularities of a) $\frac{e^{2z}}{(z-1)^4}$ b) $ze^{\frac{1}{z}}$

12. Evaluate $\int_C \frac{dz}{z^2 Sinhz}$ where C;|z-1|=2.

**Section-C** **(5X2=10 Marks)**

**Answer any FIVE questions.**

13. Find eigenvalues of $\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}$.

14. If $A=\begin{bmatrix}1 & 4\\3 & 2\end{bmatrix}$ by Cayley Hamilton theorem find an expression for finding $A^{-1}$.

15. Define an orthonormal set.

16. If $\alpha$=(2,1+i,i),$\beta$=(2-i,2,1+2i) are two vectors in $C^3$ with standard inner product .Find $<\alpha,\beta>$ .

17. Evaluate $\int \frac{logz}{(z-1)^3}dz$ where C; $|z-1|=\frac{1}{4}$.

18. Find nature of singularity $\frac{1-Cosz}{z^2}$.

19. Evaluate $\int \frac{e^z}{z^2+4}dz$ where C;|z-1|=2.

20. Evaluate $\oint_C \frac{2z+1}{(2z-1)^2}dz$.

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# GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)
## BEGUMPET, HYDERABAD

## DEPARTMENT OF MATHEMATICS

## PAPER: VIII (A) (Semester - VI)
## NUMERICAL ANALYSIS
### Syllabus

**Unit-I:**

**Curve Fitting:** Least-Squares curve fitting procedures, fitting a straight line, nonlinear Curve fitting, Curve fitting by a sum of exponentials.

**Unit-II:**

**Numerical Differentiation and Numerical Integration:** Numerical differentiation, Errors in numerical differentiation, Maximum and minimum values of a tabulated function. Numerical integration, Trapezoidal rule, Simpson's 1/3 – rule, Simpson's 3/8 – rule, Boole's and Weddle's rule.

**Unit-III:**

**Linear systems of equations:** Solution of linear systems – Direct methods, Matrix Inversion method, Gaussian elimination method, Method of factorization, Ill-conditioned Linear systems. Iterative methods: Jacobi's method, Gauss-siedal method.

**Unit-IV:**

**Numerical solution of ordinary differential equations :** Introduction, Solution by Taylor's Series, Picard's method of successive approximations, Euler's method, ModifiedEuler's method, Runge – Kutta methods, Predictor – Corrector methods, Milne's method.

**Prescribed text Book:** Scope as in Introductory Methods of Numerical Analysis by S.S.Sastry, Prentice Hall India (4th Edition.)

**Reference Books:**

~~1.~~ Numerical Analysis by ~~G. Shanker Rao, New Age International Publishers, Hyderabad.~~ S.S. Sastry Shankar Rao.
2. Finite Differences and Numerical Analysis by H.C. Saxena, S. Chand and Company, New Delhi.

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Max Marks: 75
Time: $2\frac{1}{2}$hr.

GOVERNMENT DEGREE COLLEGE FOR WOMEN
BEGUMPET, HYDERABAD.
AUTONOMOUS
NAAC ACCREDITED "B"
CBCS
MODEL PAPER
SEMESTER-VI
Numerical Analysis Paper VIII

## SECTION-A

**Answer All Questions.** 4×10=40 Marks

1. Fit a straight line to the form y=a+bx for the following data

| | | | | | | |
|---|---|---|---|---|---|---|
| x | 0 | 5 | 10 | 15 | 20 | 25 |
| Y | 12 | 15 | 17 | 22 | 24 | 30 |

OR

b) Find the curve of best fit of the type $y=ae^{bx}$ to the following data by the method of least squares.

| | | | | | |
|---|---|---|---|---|---|
| x | 1 | 5 | 7 | 9 | 12 |
| y | 10 | 15 | 12 | 15 | 21 |

2. a)Find the first two derivatives of the function tabulated below at x=0.6.

| | | | | | |
|---|---|---|---|---|---|
| x | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
| y | 1.5836 | 1.7974 | 2.0442 | 2.3275 | 2.6511 |

OR

b)Obtain an approximate value of $\pi$ from the equation $\frac{\pi}{4}=\int_0^1 \frac{1}{1+x^2}\,dx$ using Simpson's $\frac{3}{8}$ rule with 9 ordinates.

3. a) Solve the equations 2x+3y+z=9;x+2y+3z=6;3x+y+2z=8 by factorization method.

OR

b) Solve using Gauss –Seidal iterative method.

4. a) Given that $\frac{dy}{dx}$=1+xy and y(0)=1,compute y(0.1) and y(0.2) using Picards method.

OR

b) Apply the fourth order Runge-Kutta method to find an approximate value of y when x=1.2 in steps of 0.1,given that $y'=x^2+y^2$,y(1)=1.5.

## SECTION-B

**Answer any Five Questions.**

5×5=25Marks

5. By the method of least squares,find the straight line that best fits the following data:

| | | | | | |
|---|---|---|---|---|---|
| x | 1 | 2 | 3 | 4 | 5 |
| Y | 14 | 27 | 40 | 55 | 68 |

6. Fit $y = a(b^x)$ by the method of least squares to the data given below

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| y | 10 | 21 | 35 | 59 | 92 | 200 | 400 | 610 |

7. From the following table ,find x, correct to four decimals places. for which y is minimum and find this value of y.

| | | | | |
|---|---|---|---|---|
| x | 0.60 | 0.65 | 0.70 | 0.75 |
| y | 0.6221 | 0.6155 | 0.6138 | 0.6170 |

8. Evaluate $\int_0^1 x^3$ dx with five sub intervals by Trapezoidal rule.
9. Solve the system of equations 3x+y-z=3;2x-8y+z= -5; x-2y+9z=8 using Gauss elimination method.
10. Explain Tri angularisation method.
11. Using Taylor's series method, solve the equation $\frac{dy}{dx}=x^2 + y^2$for x=0.4,given that y=0 when x=0.
12. Using Euler's method, compute y(0.3) with h=0.1 from the following y'=x+y .y(0)=1.

## SECTION-C

**Answer any Five Questions.** $5\times 2 = 10$Marks

13. Write normal equations to fit a straight line.
14. Explain least square method.
15. Write formulas of first and second derivatives using Newton's forward difference formula.
16. Write Weddel's formula.
17. Explain about linear system of equations in matrix notation.
18. Define matrix norm and condition number.
19. Write fourth order Runge –Kutta formula.
20. Write Predictor –corrector formula.

GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)

BEGUMPET, HYDERABAD – 16

B.Sc MATHEMATICS Semester III & IV

Panel of Examiners for Paper III & IV

| S.No. | Name | Designation | Teaching Experience | Address |
|---|---|---|---|---|
| 1 | Dr. Vijaya Lakshmi | Lecturer Dept. of Mathematics | 23 yrs | Loyola Academy, Hyderabad Mobile: 9849970835 |
| 2 | Mrs. P. Rekha | Lecturer Dept. of Mathematics | 15 yrs | St. Francis College for Women, Begumpet, Hyderabad Mobile: 9000603572 |
| 3 | Mrs. K. Sharadha | Lecturer Dept. of Mathematics | 4 yrs | S.V. Govt. Degree College, Vidyanagar, Hyderabad Mobile: 9440014536 |
| 4 | Mr. Rami Reddy | Lecturer Dept. of Mathematics | 2 yrs | Govt. Degree College, Khairtabad, Hyderabd Mobile: 9908681668 |

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**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)**

**BEGUMPET, HYDERABAD – 16**

**B.Sc MATHEMATICS Semester V & VI**

**Panel of Examiners for Paper V & VI**

| S.No. | Name | Designation | Teaching Experience | Address |
|---|---|---|---|---|
| 1 | Dr. Vijaya Lakshmi | Lecturer Dept. of Mathematics | 23 yrs | Loyola Academy, Hyderabad Mobile: 9849970835 |
| 2 | Mrs. G. S. Mini | Lecturer Dept. of Mathematics | 19 yrs | Bhavan's Vivekananda College, Sainikpuri Mobile: 9848022442 |
| 3 | Mrs. P. Rekha | Lecturer Dept. of Mathematics | 15 yrs | St. Francis College for Women, Begumpet, Hyderabad Mobile: 9000603572 |
| 4 | Mr. P. Satyanarayana Reddy | Lecturer Dept. of Mathematics | 4 yrs | Govt. Degree college, Khairtabad, Hyderabd Mobile: 9393379694 |

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**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS)**

**BEGUMPET, HYDERABAD – 16**

**B.Sc MATHEMATICS Semester V & VI**

**Panel of Examiners for Paper VII & VIII**

| S.No. | Name | Designation | Teaching Experience | Address |
|---|---|---|---|---|
| 1 | Mrs. G. S. Mini | Lecturer Dept. of Mathematics | 19 yrs | Bhavan's Vivekananda College, Sainikpuri Mobile: 9848022442 |
| 2 | Mrs. S. Vijaya Lakshmi | Head Dept. of Mathematics | 10 yrs | Saifabad Science College, Hyderabad Mobile: 9490520680 |
| 3 | Mrs. K. Sharadha | Lecturer Dept. of Mathematics | 4 yrs | S.V. Govt. Degree College, Vidyanagar, Hyderabad Mobile: 9440014536 |
| 4 | Mrs. P. Sridevi | Lecturer Dept. of Mathematics | 3 yrs | Govt. City College, Hyderabad Mobile: 9700603152 |

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UPSC mains

Concept of core competence, Strategic flexibility; Reinventing strategy; Strategy and structure; chief Executive and Board; turnaround management; Management of strategic change; Strategic alliances, Mergers and Acquisitions; Strategy and corporate evolution in the Indian context.

**6. International Business :**

International Business Environment : Changing composition of trade in goods and services; India's Foreign Trade: Policy and trends; Financing of International trade; Regional Economic Cooperation; FTAs; Internationalisation of service firms; International production; Operation Management in International companies; International Taxation; Global competitiveness and technological developments; Global E-Business; Designing global organisational structure and control; Multicultural management; Global business strategy; Global marketing strategies; Export Management; Export-Import procedures; Joint Ventures; Foreign Investment: Foreign direct investment and foreign portfolio investment; Cross-border Mergers and Acquisitions; Foreign Exchange Risk Exposure Management; World Financial Markets and International Banking; External Debt Management; Country Risk Analysis.

## MATHEMATICS

### PAPER I

**(1) Linear Algebra :**

Vector spaces over R and C, linear dependence and independence, subspaces, bases, dimensions, Linear transformations, rank and nullity, matrix of a linear transformation.

Algebra of Matrices; Row and column reduction, Echelon form, congruence's and similarity; Rankof a matrix; Inverse of a matrix; Solution of system of linear equations; Eigenvalues and eigenvectors, characteristic polynomial, Cayley-Hamilton theorem, Symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal and unitary matrices and their eigenvalues.

**(2) Calculus :**

Real numbers, functions of a real variable, limits, continuity, differentiability, mean-value theorem, Taylor's theorem with remainders, indeterminate forms, maxima and minima, asymptotes; Curve tracing; Functions of two or three variables; Limits, continuity, partial derivatives, maxima and minima, Lagrange's method of multipliers, Jacobian.

Riemann's definition of definite integrals; Indefinite integrals; Infinite and improper integral; Double and triple integrals (evaluation techniques only); Areas, surface and volumes.

**(3) Analytic Geometry :**

Cartesian and polar coordinates in three dimensions, second degree equations in three variables, reduction to Canonical forms; straight lines, shortest distance between two skew lines, Plane, sphere, cone, cylinder, paraboloid, ellipsoid, hyperboloid of one and two sheets and their properties.

**(4) Ordinary Differential Equations :**

Formulation of differential equations; Equations of first order and first degree, integrating factor; Orthogonal trajectory; Equations of first order but not of first degree, Clairaut's equation, singular solution.

Second and higher order liner equations with constant coefficients, complementary function, particular integral and general solution.

Section order linear equations with variable coefficients, Euler-Cauchy equation;

Determination of complete solution when one solution is known using method of variation of parameters.

Laplace and Inverse Laplace transforms and their properties, Laplace transforms of elementary functions. Application to initial value problems for 2nd order linear equations with constant coefficients.

**(5) Dynamics and Statics :**

Rectilinear motion, simple harmonic motion, motion in a plane, projectiles; Constrained motion; Work and energy, conservation of energy; Kepler's laws, orbits under central forces.

Equilibrium of a system of particles; Work and potential energy, friction, Common catenary; Principle of virtual work; Stability of equilibrium, equilibrium of forces in three dimensions.

**(6) Vector Analysis :**

Scalar and vector fields, differentiation of vector field of a scalar variable; Gradient, divergence and curl in cartesian and cylindrical coordinates; Higher order derivatives; Vector identities and vector equation.

Application to geometry : Curves in space, curvature and torsion; Serret-Furenet's formulae.

Gauss and Stokes' theorems, Green's indentities.

**PAPER II**

**(1) Algebra :**

Groups, subgroups, cyclic groups, cosets, Lagrange's Theorem, normal subgroups, quotient groups, homomorphism of groups, basic isomorphism theorems, permutation groups, Cayley's theorem.

Rings, subrings and ideals, homomorphisms of rings; Integral domains, principal ideal domains, Euclidean domains and unique factorization domains; Fields, quotient fields.

**(2) Real Analysis :**

Real number system as an ordered field with least upper bound property; Sequences, limit of a sequence, Cauchy sequence, completeness of real line; Series and its convergence, absolute and conditional convergence of series of real and complex terms, rearrangement of series. Continuity and uniform continuity of functions, properties of continuous functions on compact sets.

Riemann integral, improper integrals; Fundamental theorems of integral calculus.

Uniform convergence, continuity, differentiability and integrability for sequences and series of functions; Partial derivatives of functions of several (two or three) variables, maxima and minima.

**(3) Complex Analysis :**

Analytic function, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formula, power series, representation of an analytic function, Taylor's series; Singularities; Laurent's series; Cauchy's residue theorem; Contour integration.

**(4) Linear Programming :**

Linear programming problems, basic solution, basic feasible solution and optimal solution; Graphical method and simplex method of solutions; Duality.

Transportation and assignment problems.

**(5) Partial Differential Equations :**

Family of surfaces in three dimensions and formulation of partial differential equations; Solution of quasilinear partial differential equations of the first order, Cauchy's method of characteristics; Linear partial differential equations of the second order with constant coefficients, canonical form; Equation of a vibrating string, heat equation, Laplace equation and their solutions.

**(6) Numerical Analysis and Computer Programming :**

Numerical methods: Solution of algebraic and transcendental equations of one variable by bisection, Regula-Falsi and Newton-Raphson methods, solution of system of linear equations by Gaussian Elimination and Gauss-Jorden (direct), Gauss-Seidel (iterative) methods. Newton's (forward and backward) and interpolation, Lagrange's interpolation.

Numerical integration: Trapezoidal rule, Simpson's rule, Gaussian quadrature formula.

Numerical solution of ordinary differential equations : Eular and Runga Kutta methods.

Computer Programming : Binary system; Arithmetic and logical operations on numbers; Octal and Hexadecimal Systems; Conversion to and from decimal Systems; Algebra of binary numbers.

Elements of computer systems and concept of memory; Basic logic gates and truth tables, Boolean algebra, normal forms.

Representation of unsigned integers, signed integers and reals, double precision reals and long integers.

Algorithms and flow charts for solving numerical analysis problems.

**(7) Mechanics and Fluid Dynamics :**

Generalised coordinates; D'Alembert's principle and Lagrange's equations; Hamilton equations; Moment of inertia; Motion of rigid bodies in two dimensions.

Equation of continuity; Euler's equation of motion for inviscid flow; Stream-lines, path of a particle; Potential flow; Two-dimensional and axisymmetric motion; Sources and sinks, vortex motion; Navier-Stokes equation for a viscous fluid.

## MECHANICAL ENGINEERING

## PAPER I

**1. Mechanics :**

**1.1 Mechanics of Rigid Bodies :**

Equations of equilibrium in space and its application; first and second moments of area; simple problems on friction; kinematics of particles for plane motion; elementary particle dynamics.

**1.2 Mechanics of Deformable Bodies :**

Generalized Hooke's law and its application; design problems on axial stress, shear stress and bearing stress; material properties for dynamic loading; bending shear and stresses in beams; determination of principle stresses and strains-analytical and graphical; compound and combined stresses; bi-axial stresses-thin walled pressure vessel; material behaviour and design factors for dynamic load; design of circular shafts for bending and torsional load only; deflection of beam for statically determinate problems; theories of failure.

**2.Engineering Materials :**