REGULATIONS FOR B. Sc. MATHEMATICS DEGREE COURSE  
Semester System  
(with effect from 2007-2008)

1. **Eligibility for Admission to the Course**  
Candidate for admission to the first year of the B. Sc. Mathematics degree course shall be required to have passed the higher secondary examination conducted by the Govt. of Tamil Nadu with Mathematics as one of the papers only eligible or other examinations accepted as equivalent there to by the Syndicate, subject to such other conditions as may be prescribed therefor. Business Mathematics, General Mathematics and Statistics subject at HSC can **not be considered** as equivalent to Mathematics.

2. **Duration of the Course**  
The course shall extend over a period of three years comprising of six semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

3. **Course of Study**  
The course of study for the UG degree course shall consist of the following

a) **Part - I**  
Tamil or any one of the following modern/classical languages i.e. Telugu, Kannada, Malayalam, Hindi, Sanskrit, French, German, Arabic & Urdu. It shall be offered during the first four semesters with one examination at the end of each semester.

b) **Part – II : English**  
The subject shall be offered during the first four semesters with one examination at the end of each semester. During third semester Part II English will be offered as communication skills.

c) **Foundation Course**  
The Foundation course shall comprise of two stages as follows:  
Foundation Course A : General Awareness (I & II semesters)  
Foundation Course B : Environmental Studies (III & IV semesters)

The syllabus and scheme of examination for the foundation course A, General awareness shall be apportioned as follows.

From the printed material supplied by the University - 75%  
Current affairs & who is who? - 25%

The current affairs cover current developments in all aspects of general knowledge which are not covered in the printed material on this subject issued by the University.
The Foundation course B shall comprise of only one paper which shall have Environmental Studies.

d) Part – III

**Group A**: Core subject – As prescribed in the scheme of examination.
Examination will be conducted in the core subjects at the end of every semester.

**Group B**: allied subjects -2 subjects-4 papers
Examination shall be conducted in the allied subjects at the end of first four semesters.

**Group C**: application oriented subjects: 2 subjects – 4 papers
The application-oriented subjects shall be offered during the last two semesters of study viz., V and VI semesters. Examination shall be conducted in the subjects at the end of V & VI semesters.

**Group D**: field work/institutional training
Every student shall be required to undergo field work/institutional training, related to the application-oriented subject for a period of not less than 2 weeks, conveniently arranged during the course of 3rd year. The principal of the college and the head of the department shall issue a certificate to the effect that the student had satisfactorily undergone the field work/institutional training for the prescribed period.

**Diploma Programme**:  
All the UG programmes shall offer compulsory diploma subjects and it shall be offered in four papers spread over each paper at the end of III, IV, V, & VI semesters.

e) **Co-Curricular activities: NSS/NCC/Physical education**
Every student shall participate compulsorily for period of not less than two years (4 semesters) in any one of the above programmes.

The above activities shall be conducted outside the regular working hours of the college. The principal shall furnish a certificate regarding the student’s performance in the respective field and shall grade the student in the five point scale as follows

- A-Exemplary
- B-very good
- C-good
- D-fair
- E-Satisfactory

This grading shall be incorporated in the mark sheet to be issued at the end of the appropriate semester (4th or 5th or 6th semester).

(Handicapped students who are unable to participate in any of the above activities shall be required to take a test in the theoretical aspects of any one of the above 3 field and be graded and certified accordingly).
4. **Requirement to appear for the examinations**

   a) a candidate will be permitted to appear for the university examinations for any semester if
      
      i) He/she secures not less than 75% of attendance in the number of working days during the semester.
      
      ii) He/she earns a progress certificate from the head of the institution, of having satisfactory completed the course of study prescribed in the subjects as required by these regulations, and
      
      iii) His/her conduct has been satisfactory.

      Provided that it shall be open to the syndicate, or any authority delegated with such powers by the syndicate, to grant exemption to a candidate who has failed to earn 75% of the attendance prescribed, for valid reasons, subject to usual conditions.

   b) A candidate who has secured less than 65% but 55% and above attendance in any semester has to compensate the shortage in attendance in the subsequent semester besides, earning the required percentage of attendance in that semester and appear for both semester papers together at the end of the latter semester.

   c) A candidate who has secured less than 55% of attendance in any semester will not be permitted to appear for the regular examinations and to continue the study in the subsequent semester. He/she has to rejoin the semester in which the attendance is less than 55%.

   d) A candidate who has secured less than 65% of attendance in the final semester has to compensate his/her attendance shortage in a manner as decided by the concerned head of the department after rejoining the same course.

5. **Restrictions to appear for the examinations**

   a) Any candidate having arrear paper(s) shall have the option to appear in any arrear paper along with the regular semester papers.

   b) “Candidates who fail in any of the papers in Part I, II & III of UG degree examinations shall complete the paper concerned within 5 years form the date of admission to the said course, and should they fail to do so, they shall take the examination in the texts/revised syllabus prescribed for the immediate next batch of candidates. If there is no change in the texts/syllabus they shall appear for the examination in that paper with the syllabus in vogue until there is a change in the texts or syllabus. In the event of removal of that paper consequent to change of regulation and/or curriculum after 5 year period, the candidates shall have to take up an equivalent paper in the revised syllabus as suggested by the chairman and fulfill the requirements as per regulation/curriculum for the award of the degree.

6. **Medium of Instruction and examinations**

   The medium of instruction and examinations for the papers of Part I and II shall be the language concerned. For part III subjects other than modern languages, the medium of instruction shall be either Tamil or English and the medium of examinations is in English/Tamil irrespective of the medium of instructions. For modern languages, the medium of instruction and examination will be in the languages concerned.
7. **Submission of Record Note Books for practical examinations**
Candidates appearing for practical examinations should submit bonafide Record Note Books prescribed for practical examinations, otherwise the candidates will not be permitted to appear for the practical examinations. However, in genuine cases where the students, who could not submit the record note books, they may be permitted to appear for the practical examinations, provided the concerned Head of the department from the institution of the candidate certified that the candidate has performed the experiments prescribed for the course. For such candidates who do not submit Record Books, zero (0) marks will be awarded for record note books.

8. ** Passing Minimum**
   a) A candidate who secures not less than 40% of the total marks in any subject including the Diploma and Foundation courses (theory or Practical) in the University examination shall be declared to have passed the examination in the subject (theory or Practical).
   b) A candidate who passes the examination in all the subjects of Part I, II and III (including the Diploma and Foundation courses) shall be declared to have passed, the whole examination.

9. **Improvement of Marks in the subjects already passed**
Candidates desirous of improving the marks awarded in a passed subject in their first attempt shall reappear once within a period of subsequent two semesters. The improved marks shall be considered for classification but not for ranking. When there is no improvement, there shall not be any change in the original marks already awarded.

10. **Classification of Successful candidates**
   a) A candidate who passes all the Part III examinations in the First attempt within a period of three years securing 75% and above in the aggregate of Part III marks shall be declared to have passed B.A/ B.Sc./B.Com./B.B.M. degree examination in **First Class with Distinctions**
   b) (i) A candidate who passes all the examinations in Part I or Part II or Part III or Diploma securing not less than 60 per cent of total marks for concerned part shall be declared to have passed that part in **First Class**
   (ii) A candidate who passed all the examinations in Part I or Part II or Part III or Diploma securing not less than 50 per cent but below 60 per cent of total marks for concerned part shall be declared to have passed that part in **Second Class**
   (iii) All other successful candidates shall be declared to have passed the Part I or Part II or Part III or Diploma examination in **Third Class**

11. **Conferment of the Degree**
No candidate shall be eligible for conferment of the Degree unless he / she,
   i. has undergone the prescribed course of study for a period of not less than six semesters in an institution approved by/affiliated to the University or has been exempted from in the manner prescribed and has passed the examinations as have been prescribed therefor.
   ii. Has satisfactory participates in either NSS or NCC or Physical Education as evidenced by a certificate issued by the Principal of the institution.
   iii. Has successfully completed the prescribed Field Work/ Institutional Training as evidenced by certificate issued by the Principal of the College.
12. **Ranking**  
A candidate who qualifies for the UG degree course passing all the examinations in the first attempt, within the minimum period prescribed for the course of study from the date of admission to the course and secures I or II class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular branch of study, subject to a maximum of 10 ranks.  
The improved marks will not be taken into consideration for ranking.

13. **Additional Degree**  
Any candidate who wishes to obtain an additional UG degree not involving any practical shall be permitted to do so and such candidate shall join a college in the III year of the course and he/she will be permitted to appear for Part III alone by granting exemption form appearing Part I, Part II and common allied subjects (if any), already passed by the candidate. And a candidate desirous to obtain an additional UG degree involving practical shall be permitted to do so and such candidate shall join a college in the II year of the course and he/she be permitted to appear for Part III alone by granting exemption form appearing for Part I, Part II and the common allied subjects. If any, already passed. Such candidates should obtain exemption from the university by paying a fee of Rs.500/-.

14. **Evening College**  
The above regulations shall be applicable for candidates undergoing the respective courses in Evening Colleges also.

15. **Syllabus**  
The syllabus for various subjects shall be clearly demarcated into five viable units in each paper/subject.

16. **Revision of Regulations and Curriculum**  
The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise/amend/change the Regulations and Scheme of Examinations, if found necessary.

17. **Transitory Provision**  
Candidates who have undergone the Course of Study prior to the Academic Year 2007-2008 will be permitted to take the Examinations under those Regulations for a period of four years i.e. up to and inclusive of the Examination of April 2012 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.
BHARATHIAR UNIVERSITY::COIMBATORE-641 046
Group A: B. Sc. (MATHEMATICS) WITH COMPULSORY DIPLOMA IN
OPERATION RESEARCH
(For the students admitted from the academic year 2007-2008 and onwards)
Scheme of Examination

First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Part</th>
<th>Subject and Paper</th>
<th>Instruction hour/week</th>
<th>University Examination</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>I</td>
<td>Language-I - Paper-I</td>
<td>6</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>English - Paper-I</td>
<td>6</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Gr.A Core-Paper I - Classical Algebra</td>
<td>4</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core-Paper II-Calculus</td>
<td>5</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.B Allied A - Paper I</td>
<td>7</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chosen by the college</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foundation Course A</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Part</th>
<th>Subject and Paper</th>
<th>Instruction hour/week</th>
<th>University Examination</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>I</td>
<td>Language-I-Paper-II</td>
<td>6</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>English - Paper-II</td>
<td>6</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Gr.A Core-Paper III - Analytical Geometry</td>
<td>4</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core-Paper IV- Trigonometry, Vector Calculus and Fourier Series</td>
<td>5</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Allied - Paper II</td>
<td>7</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chosen by the college</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foundation Course A</td>
<td>2</td>
<td>3</td>
<td>100</td>
</tr>
</tbody>
</table>

Diploma in Operations Research - Paper-I
<table>
<thead>
<tr>
<th>Semester</th>
<th>Part</th>
<th>Subject and Paper</th>
<th>Instruction hour/week</th>
<th>University Examination</th>
<th>Duration In Hrs</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>I</td>
<td>Language-I- Paper -IV</td>
<td>6</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>English - Paper -IV</td>
<td>6</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Gr.A Core-Paper VII-Dynamics</td>
<td>3</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core-Paper VIII-Programming in C</td>
<td>3</td>
<td></td>
<td>3</td>
<td>100 *</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.B Allied B - Paper II – Chosen by the college</td>
<td>5</td>
<td></td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Practicals (Allied)</td>
<td>2</td>
<td></td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foundation Course B</td>
<td>2</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diploma in Operations Research – Paper II</td>
<td>3</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Third Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>III</td>
<td>Gr.A Core- Paper IX-Real Analysis-I</td>
<td>5</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core-Paper X-Complex Analysis-I</td>
<td>6</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core - Paper XI-Modern Algebra-I</td>
<td>6</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.C- Appl. Ori.Sub. A-Paper-I</td>
<td>5</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.C- Appl. Ori.Sub. A-Paper-II</td>
<td>5</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diploma in Operations Research Paper III</td>
<td>3</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>VI</td>
<td>III</td>
<td>Gr.A Core Paper XII Real Analysis-II</td>
<td>5</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core-Paper XIII Complex Analysis-II</td>
<td>6</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.A Core- Paper XIV Modern Algebra-II</td>
<td>6</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.C- Appl. Ori. Sub. B-Paper-I</td>
<td>5</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gr.C- Appl. Ori. Sub. B-Paper - II</td>
<td>5</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diploma in Operations Research - Project</td>
<td>3</td>
<td></td>
<td>3</td>
<td>100</td>
</tr>
</tbody>
</table>

* - All Computer papers have Theory and Practical examinations:
  Theory - 75 marks; Practical - 25 marks
Application Oriented Subjects

<table>
<thead>
<tr>
<th>Semester V</th>
<th>Semester V I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy- I</td>
<td>Astronomy- II</td>
</tr>
<tr>
<td>Numerical Methods-I</td>
<td>Numerical Methods-II</td>
</tr>
<tr>
<td>Discrete Maths</td>
<td>Automata Theory &amp; Formal Languages</td>
</tr>
<tr>
<td>Graph Theory</td>
<td>Programmin in C++.</td>
</tr>
<tr>
<td>RDBMS &amp; Oracle.</td>
<td>Internet and Java Programming.</td>
</tr>
</tbody>
</table>

Note:-In case the computer subjects are chosen as AOS paper , practical exams should be conducted and the marks for the papers should be split into

\[
\begin{align*}
\text{Written Exam} & \quad - 75 \\
\text{Practical Exam} & \quad - 25 \\
\end{align*}
\]

\[\text{Total} = 100\]

Any two subjects from the following

**Allied subjects**

1. Physics
2. Chemistry
3. Accountancy
Semester: I - Core Paper- I

Subject title: Classical Algebra

Subject description: This course focuses on the convergence and divergence of different types of series, also discusses the standard methods of solving both polynomial and transcendental type equations.

Goal: To enable the students to learn about the convergence and divergence of the series and to find the roots for the different types of the equation.

Objectives: On successful completion of this course the students should gain knowledge about the convergence of series and solving equations.

UNIT I:

Binomial, exponential theorems-their statements and proofs- their immediate application to summation and approximation only.

UNIT II:

Logarithmic series theorem-statement and proof-immediate application to summation and approximation only. Convergency and divergency of series –definitions, elementary results-comparison tests-De Alemberts and Cauchy’s tests.

UNIT III:

Absolute convergence-series of positive terms-Cauchy’s condensation test-Raabe’s test.

UNIT IV

Theory of equations: Roots of an equation- Relations connecting the roots and coefficients-transformations of equations-character and position of roots-Descarte’s rule of signs-symmetric function of roots-Reciprocal equations.

UNIT V:

Multiple roots-Rolle’s theorem - position of real roots of f(x) =0 - Newton’s method of approximation to a root - Horner’s method.

Treatment as in

  S. Viswanatham (Printers & Publishers Private Ltd-2006)

Reference:
Core Paper- II

Subject title: CALCULUS
Credit hours-5

Subject description:
This course presents the idea of curvatures, integration of different types of functions, its geometrical applications, double, triple integrals and improper integrals.

Goal:
To enable the students to learn and gain knowledge about curvatures, integrations and its geometrical applications.

Objectives:
On successful completion of course the students should have gain about the evolutes and envelopes, different types of integrations, its geometrical application, proper and improper integration.

UNIT I:
Curvature-radius of curvature in Cartesian and polar forms-evolutes and envelopes- pedal equations- total differentiation- Euler’s theorem on homogeneous functions.

UNIT II:
Integration of \( \frac{f'(x)}{f(x)} \), \( f'(x) \sqrt{f(x)} \), \((px+q)/\sqrt{(ax^2+bx+c)}\), \[\sqrt{(x-a)/(b-x)}\], \[\sqrt{(x-a)(b-x)}\], \[1/\sqrt{(x-a)(b-x)}\], \[1/(acosx+bsinx+c)\], \[1/(acos^2x+bsin^2x+c)\]. Integration by parts

UNIT III:
Reduction formulae- problems- evaluation of double and triple integrals- applications to calculations of areas and volumes-areas in polar coordinates.

UNIT IV:
Change of order of integration in double integral- Jacobions.- change of variables in double and triple integrals.

UNIT V:
Notion of improper integrals, their convergence, simple tests for convergence simple problems, Beta and Gamma integrals-their properties, relation between them- evaluation of multiple integrals using Beta and Gamma functions.

Treatment as in

Reference:
Subject title: Analytical Geometry  
Credit hours-4

Subject Description:
This course gives emphasis to enhance student knowledge in two dimensional and three dimensional analytical geometry. Particularly about two dimensional conic sections in polar coordinates and the geometrical aspects of three dimensional figs, viz, sphere, cone and cylinder.

Goal:
To enable the students to learn and visualize the fundamental ideas about co-ordinate geometry.

Objectives:
On successful completion of the course students should have gained knowledge above the regular geometrical figures and their properties.

UNIT I:
Analytical geometry of 2D-polar coordinates equation of a conic -directrix-chord-tangent-normal- simple problems.

UNIT II:
Analytical Geometry 3D-stright.lines-coplanarity of straight-line-shortest distance (S.D) and equation of S.D between two lines-simple problems.

UNIT III:
Sphere: standard equation of sphere-results based on the properties of a sphere-tangent plane to a sphere- equation of a circle.

UNIT IV:
Cone and cylinder: Cone whose vertex is at the origin- envelope cone of a sphere-right circular cone-equation of a cylinder-right circular cylinder.

UNIT V:
Conicoides: Nature of a conicoide- standard equation of central conicoid –enveloping cone- tangent plane-condition for tangency –director Sphere- director plane

Treatment as in
1. Analytical Geometry by P. Durai Pandian & others  
2. Solid Geometry by N.P. Bali- Laxmi Publications (P) Ltd

Reference:
1. Analytical Geometry of 2D by T.K. M. Pillai and Others – Visvanathan Publications-2006  
2. Solid Geometry by M.L. Khanna- Jainath & Co Publishers, Meerut
Semester II - Core Paper – IV

Subject Title: Trigonometry, Vector Calculus and Fourier Series

Credit Hours: 5

Subject Description: This course presents the circular functions, hyperbolic functions, differentiation of functions in scalar and vector field.

Goals: To enable the students to learn about the expansion of trigonometrical functions and to gain knowledge about vector treatment which will help them to deal the analytical geometry problems using vector method.

Objectives: On successful completion of this course the students should have gained knowledge about expansion of trigonometric functions, line integral, surface integral, volume integral and Fourier series.

Unit I:
Expansion in Series – Expansion of $\cos^n \theta$, $\sin^n \theta$, in a series of cosines and sines of multiples of $\theta$ – Expansions of $\cos n\theta$ and $\sin n\theta$ in powers of sines and cosines – Expansion of $\sin \theta$, $\cos \theta$ and $\tan \theta$ in powers of $\theta$ – hyperbolic functions and inverse hyperbolic functions.

Unit II:
Logarithm of complex quantities - summation of series – when angles are in arithmetic progression – C + iS method of summation – method of differences.

Unit III:
Scalar and vector fields –Differentiation of vectors – Gradient, Divergence and Curl.

Unit IV:
Integration of vectors – line integral – surface integral – Green’s theorem in the plane – Gauss divergence theorem – Strokes theorem – (Statements only) - verification of the above said theorems.

Unit V:
Periodic functions – Fourier series of periodicity $2\pi$ – half range series.

Treatment as in

References:

Semester: III - Core paper V

Subject Title: Differential Equations and Laplace Transforms  Credit Hours: 3

Subject Descriptions:
This course presents the method of solving ordinary differential Equations of First Order and
Second Order, Partial Differential equations. Also it deals with Laplace Transforms, its inverse and
Application of Laplace Transform in solving First and Second Order Differential Equations with
costant coefficients.

Goals: It enables the students to learn the method of solving Differential Equations.

Objectives: End of this course, the students should gain the knowledge about the method of solving
Differential Equations. It also exposes Differential Equation as a powerful tool in solving problems
in Physical and Social sciences.

Unit I:
Ordinary Differential Equations: Equations of First Order and of Degree Higher than one –
Solvable for $p, x, y$ – Clairaut’s Equation – Simultaneous Differential Equations with constant
coefficients of the form
i) $f_1(D)x + g_1(D)y = \phi_1(t)$  
ii) $f_2(D)x + g_2(D)y = \phi_2(t)$

where $f_1, g_1, f_2$ and $g_2$ are rational functions $D = \frac{d}{dt}$ with constant coefficients $\phi_1$ and $\phi_2$ explicit
functions of $t$.

Unit II:
Finding the solution of Second and Higher Order with constant coefficients with Right Hand
Side is of the form $Ve^{ax}$ where $V$ is a function of $x$ – Euler’s Homogeneous Linear Differential
Equations – Method of variation of parameters.

Unit III:
Partial Differential Equations: Formation of equations by eliminating arbitrary constants and
arbitrary functions – Solutions of P.D Equations – Solutions of Partial Differential Equations by
direct integration – Methods to solve the first order P.D. Equations in the standard forms -
Lagrange’s Linear Equations.

Unit IV:
Laplace Transforms: Definition – Laplace Transforms of standard functions – Linearity
property – Firsting Shifting Theorem – Transform of $tf(t), \frac{f(t)}{t}, f'(t), f^{(1)}(t)$.

Unit V:
Inverse Laplace Transforms – Applications to solutions of First Order and Second Order
Differential Equations with constant coefficients.

Treatment as in

References:
1) S. Narayanan and T.K. Manickavasagam Pillai, Calculus, S. Viswanathan (Printers and Publishers)
Pvt. Ltd, Chennai 1991
2) N.P. Bali, Differential Equations, Laxmi Publication Ltd, New Delhi, 2004
3) Dr. J. K. Goyal and K.P. Gupta, Laplace and Fourier Transforms, Pragali Prakashan Publishers,
Meerut, 2000
Semester: III - Core Paper – VI

Subject title: Statics

Subject Description:
This course contains the nature of forces acting on a surface, friction and center of gravity.

Goal:
To enable the students to realize the nature of forces and resultant forces when more than one force acting on a particle.

Objectives:
On successful completion of course the students should realize the concept about the forces, resultant force of more than one force acting on a surface, friction and center of gravity. Also he can differentiate static and dynamic forces.

UNIT-I
Forces acting at a point – Parallelogram law-triangle law-(λ, µ) theorem-Polygon of forces-conditions of equilibrium.

UNIT- II
Parllel Forces-Moments and couples composition of parallel forces (like and unlike)-Moment of a force about a point-Varignons theorem.

UNIT – III
Co-planar forces acting on a rigid body – Theorem on three co-planar forces in equilibrium-reduction of a system of co-planar forces to a single force and a couple - necessary & sufficient conditions of equilibrium only – Equation to the line of action of the resultant.

UNIT – IV
Friction:
Laws of friction-angle-co efficient, and cone of friction.

UNIT – V
Center of gravity (using integration only)-Equilibrium of strings and chains.

Treatment as in

References
Semester III - Diploma Course

Subject title: Diploma in Operations Research – Paper I  Credit hours: 3

Subject description:
This course contains advantages, limitations and applications of O.R, formulation of Linear Programming Problems (L.P.P), methods to solve L.P.P. like simplex method, Charnes Penality Method and Two Phase Simplex method. Also it deals about duality in L.P.P, Transportation and Assignment Problems with applications.

Goal:
It enables the students to use the mathematical knowledge in optimal use of resources.

Objectives:
On successful completion of this course students should have gained knowledge about optimal use of resources.

Unit I:

Unit II:
Simplex Method – Charnes Penality Method (or) Big – M Method - Two Phase Simplex method – Problems.

Unit III:
Duality in L.P.P – Concept of duality – Duality and Simplex Method – Problems

Unit IV:
The transportation Problems – Basic feasible solution by L.C.M – NWC- VAM- optimum solutions – unbalanced Transportation problems

Unit V:

References:
SEMESTER IV - Core Paper – VII

Subject title: Dynamics  Credit hours: 3

Subject Description: This course provides the knowledge about the field Kinematics, projectile, simple harmonic motion and impact of a particle on a surface.
Goal: To enable the students to apply Laws, Principles, Postulates governing the Dynamics in physical reality.
Objectives: End of this course, the student understand the reason for dynamic changes in the body.

UNIT – I

Kinematic-Velocity-Acceleration.
Motion of a straight line: Equations of motion –acceleration of falling bodies-vertical motion under gravity-motion down a smooth inclined plane.

Laws of Motion:
Newton’s laws of motion, Newton’s law of gravitation-conservation of linear momentum-work done by an elastic string-conservative forces-energy-potential energy and Kinetic energy-principle of energy.

UNIT – II

Projectiles: Path of a projectile-Greatest height-time of flight-range on an inclined plane through the point of projection-Maximum range.

UNIT – III


UNIT – IV

Simple Harmonic Motion: Amplitude, periodic time, phase-composition of two simple harmonic motions of the same period in a straight line and in two perpendicular lines.

UNIT – V


Treatment as in

References
SEMESTER IV: GROUP A – CORE PAPER VIII

Subject Title: Programming in C * No.of.Hours: 3

Subject Description: This paper presents the importance of C language, its structure, Data types, Operators of C, Various control statements, Arrays, different types of functions and practical problems.

Goals: To enable the students to learn about the basic structure, Statements, arrays, functions and various concepts of C language.

Objectives: On successful completion of the course the students should have:
Learnt the basic structure, operators and statements of C language.
Learnt the decision making statements and to solve the problems based on it.
Learnt arrays, functions and solve the problems Regarding about it.


UNIT IV: One, Two dimensional arrays – Initiating two dimensional arrays – Multidimensional arrays – Declaring and initializing string variables – reading strings from terminal – Writing strings on the screen – Arithmetic operations on characters.

UNIT V: Pointers- understanding pointers – Accessing the address of a variable – Declaring and initializing pointers – Accessing a variable through its pointers – pointer expressions – Pointer increments and scale factor – Pointers and arrays – Pointers and functions void printers.

TEXT BOOK:

REFERENCE BOOKS:
B.SC., MATHEMATICS DEGREE COURSE C-PROGRAMMING PRACTICAL LIST.

1. Write a C program to generate ‘N’ Fibonacci number.

2. Write a C program to print all possible roots for a given quadratic equation.

3. Write a C program to calculate the statistical values of mean, median, mode, Standard Deviation and variance of the given data.

4. Write a C program to sort a set of numbers using the functions.

5. Write a C program to sort the given set of names and assign roll numbers.

6. Write a C program to search a required element in a list using binary search.

7. Write a C program to find factorial value of a given number ‘N’ using recursive function call.

8. Write a C program to find inverse and determinant of a given matrix.

9. Write a C program to find number of palindromes in a given sentence.

10. Write a C program to prepare pay list for a given data.

11. A file contains the name of students with their initials at the beginning. Write a program to read this file and write their names in another file with the initials at the end.

12. Convert a word star file into an ASCII file and store it another file.
Semester IV - Diploma Course

Subject title: Diploma in Operations Research – Paper II  
Credit hours: 3

Subject Description:
This course gives emphasis to enhance student knowledge in game theory, performance measures of queues, optimal use of Inventory and Network scheduling with application.

Unit I:
Game Theory – Two person zero sum game – The Maxmini – Minimax principle – problems - Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) graphical method – Problems.

Unit II:
Queueing Theory – Introduction – Queueing system – Characteristics of Queueing system – symbols and Notation – Classifications of queues – Problems in (M/M/1) : (∞/FIFO); (M/M/1) : (N/FIFO); (M/M/C) : (∞/FIFO); (M/M/C) : (N/FIFO) Models.

Unit III:
Inventory control – Types of inventories – Inventory costs – EOQ Problem with no shortages – Production problem with no shortages – EOQ with shortages – Production problem with shortages – EOQ with price breaks.

Unit IV:

Unit V:
PERT – PERT calculations – Cost Analysis – Crashing the Network – Problems.

References:
SEMESTER V - Core Paper – IX

Subject title: Real Analysis - I                  Credit hours: 5

Subject Description: This course focuses on the Real and Complex number systems, set theory, point set topology and metric spaces.

Goal: To introduce the concepts which provide a strong base to understand and analyze mathematics.

Objective: On successful completion of this course the students should gain the knowledge about real and complex numbers, sets and metric space.

UNIT I
The Real and Complex number systems the field axioms, the order axioms –integers –the unique Factorization theorem for integers –Rational numbers –Irrational numbers –Upper bounds, maximum Elements, least upper bound –the completeness axiom –some properties of the supremum –properties of the integers deduced from the completeness axiom- The Archimedean property of the real number system –Rational numbers with finite decimal representation of real numbers –absolute values and the triangle inequality –the Cauchy-Schwarz, inequality –plus and minus infinity and the extended real number system.

UNIT II

UNIT III
Elements of point set topology: Euclidean space \( \mathbb{R}^n \) –open balls and open sets in \( \mathbb{R}^n \). The structure of open Sets in \( \mathbb{R}^n \) –closed sets and adherent points –The Bolzano –Weierstrass theorem –the Cantor intersection Theorem.

UNIT IV
Covering –Lindelof covering theorem –the Heine Borel covering theorem –Compactness in \( \mathbb{R}^n \) –Metric Spaces –point set topology in metric spaces –compact subsets of a metric space –Boundary of a set.

UNIT V
Treatment as in
Unit I  Chapter 1  Sections 1.2, 1.3, 1.6 to 1.16, 1.18 to 1.20
Unit II  Chapter 2  Sections 2.2 to 2.15
Unit III  Chapter 3  Sections 3.2 to 3.9
Unit IV  Chapter 3  Sections 3.10 to 3.16
Unit V  Chapter 4  Sections 4.2 to 4.5, 4.8 to 4.15

References

SEMESTER V - Core Paper – X

Subject title: Complex Analysis - I  Credit hours: 6

Subject Description: This course provides the knowledge about complex number system and complex functions.

Goal: To enable the students to learn complex number system, complex function and complex integration.

Objectives: On successful completion of this course the students should gained knowledge about the origin, properties and application of complex numbers and complex functions.

UNIT I
Complex number system, Complex number –Field of Complex numbers – Conjugation – Absolute value -Argument –Simple Mappings.

i) \( w = z + \alpha \)
ii) \( w = az \)
iii) \( w = 1/z \)

invariance of cross-ratio under bilinear transformation –Definition of extended complex plane – Stereographic projection.

UNIT II

UNIT III
Power Series: Absolute convergence –circle of convergence –Analyticity of the sum of power series in the Circle of convergence (term  term differentiation of a series) Elementary functions: Exponential, Logarithmic, Trigonometric and Hyperbolic functions.
UNIT IV

Conjugate Harmonic functions: Definition and determination, Conformal Mapping: Isogonal mapping—Conformal mapping—Mapping $z \rightarrow f(z)$, where $f$ is analytic, particularly the mappings.

$w = e^z; w = z^{1/2}; w = \sin z; w = 1/2(z + 1/z)$

UNIT V

Complex Integration: Simply and multiply connected regions in the complex plane. Integration of $f(z)$ from definition along a curve joining $z_1$ and $z_2$. Proof of Cauchy’s Theorem (using Goursat’s lemma for a simply connected region). Cauchy’s integral formula for higher derivatives (statement only)—Morera’s theorem.

Treatment as in


Unit I
- Chapter 1 Sections 1.1 to 1.3, 1.6 to 1.9
- Chapter 2 Sections 2.1 to 2.2, 2.6 to 2.9,
- Chapter 7 Section 7.1

Unit II
- Chapter 4 Sections 4.1 to 4.10

Unit III
- Chapter 6 Sections 6.1 to 6.11

Unit IV
- Chapter 6 Sections 6.12 to 6.13
- Chapter 7 Sections 7.6 to 7.9

Unit V
- Chapter 8 Sections 8.1 to 8.9

References

SEMESTER V - Core Paper – XI

Subject title: Modern Algebra - I  
Credit hours: 6

Subject description: This course provides knowledge about sets, mappings, different types of groups and rings.

Goals: To enable the students to understand the concepts of sets, groups and rings. Also the mappings on sets, groups and rings.

Objective: On successful completion of course the students should have concrete knowledge about the abstract thinking like sets, groups and rings by proving theorems.

UNIT I
Sets – mappings – Relations and binary operations – Groups: Abelian group, Symmetric group Definitions and Examples – Basic properties.

UNIT II

UNIT III
Homomorphisms – Cauchy’s theorem for Abelian groups – Sylow’s theorem for Abelian groups Automorphisms – Inner automorphism - Cayley’s theorem, permutation groups.

UNIT IV
Rings: Definition and Examples –Some Special Classes of Rings – Commutative ring – Field – Integral domain - Homomorphisms of Rings.

UNIT V
Ideals and Quotient Rings – More Ideals and Quotient Rings – Maximal ideal - The field of Quotients of an Integral Domain

Treatment as in
Unit I Chapter 1 Sections 1.1 to 1.3,
Chapter 2 Sections 2.1 to 2.3
Unit II Chapter 2 Sections 2.4 to 2.6
Unit III Chapter 2 Sections 2.7 to 2.10
Unit IV Chapter 3 Sections 3.1 to 3.3
Unit V Chapter 3 Sections 3.4 to 3.6.

References
SEMESTER – V - GROUP C – APPLICATION ORIENTED SUBJECT

SUBJECT TITLE: ASTRONOMY – I CREDIT HOURS: 5

Subject Description : This course focuses on the Solar system, Celestial sphere, Dip-Twilight & Keplar’s laws.

Goal: To enable the students to understand the Astronomical aspects and about the laws governing the planet movements.

Objectives: On successful completion of this course the students should gain knowledge about Astronomy.

UNIT I: 

UNIT II:
Celestial sphere – Celestial co – ordinates – Diurnal motion – Variation in length of the day.

UNIT III:
Dip – Twilight – Geocentric parallex.

UNIT IV:
Refration – Tangent formula – Cassinis formula.

UNIT V:
Kepler’s laws – Relation between true eccentric and mean anamolies.

Treatment as in “ASTRONOMY” by S.Kumaravelu and Susheela Kumaravelu.

Question paper setters to confine to the above text book only.
SEMESTER – V - GROUP C – APPLICATION ORIENTED SUBJECT
NUMERICAL METHODS - I

Subject Description:
This course presents method to solve linear algebraic and transcendental equations and system of linear equations. Also Interpolation by using finite difference formulae.

Goal:
It exposes the students to study numerical techniques as powerful tool in scientific computing.

Objective:
On successful completion of this course the student gain the knowledge about solving the linear equations numerically and finding interpolation by using difference formulae.

Unit I: The solution of numerical algebraic and transcendental Equations:

Unit II: Solution of simultaneous linear algebraic equations:

Unit III: Finite Differences:

Unit IV: Interpolation (for equal intervals):
Newton’s forward and backward formulae – equidistant terms with one or more missing values – Central differences and central difference table – Gauss forward and backward formulae – Stirlings formula.

Unit V: Interpolation (for unequal intervals):
Divided differences – Properties – Relations between divided differences and forward differences – Newton’s divided differences formula – Lagrange’s formula and inverse interpolation.

Treatment as in

References:
SEMESTER – V - GROUP C – APPLICATION ORIENTED SUBJECT

Subject Title: DISCRETE MATHEMATICS Credit Hours: 5

Subject Description: This course focuses on the mathematical logic, Relations& Functions, Formal languages and Automata, Lattices and Boolean Algebra and Graph Theories.

Goal: To enable the students to learn about the interesting branches of Mathematics.

Objectives: On successful completion of this course should gain knowledge about the Formal languages Automata Theory, Lattices & Boolean Algebra and Graph Theory.

UNIT-I:
(1-2, 1-2.7, 1-2.9, 1-2.10, 1-2.11, 1-3, 1-5.1, 1-5.2, 1-5.4, 1-6.4)

UNIT-II:
Relations and functions: Composition of relations, Composition of functions, Inverse functions, one-to- one, onto, one-to-one& onto, onto functions, Hashing functions, Permutation function, Growth of functions. Algebra structures: Semi groups, Free semi groups, Monoids, Groups, Cosets, Sets, Normal subgroups, Homomorphism.
(2-3.5, 2-3.7, 2-4.2, 2-4.3, 2-4.6, 3-2, 3-5, 3-5.3, 3-5.4)

UNIT-III:
Formal languages and Automata: Regular expressions, Types of grammar, Regular grammar and finite state automatata, Context free and sensitive grammars.
(3-3.1, 3-3.2, 4-6.2)

UNIT-IV:
Lattices and Boolean algebra: Partial ordering, Poset, Lattices, Boolean algebra, Boolean functions, Theorems, Minimisation of Boolean functions.
(4-1.1, 4-2, 4-3, 4-4.2)

UNIT-V:
Graph Theories: Directed and undirected graphs, Paths, Reachability, Connectedness, Matric representation, Eular paths, Hamiltonoan paths, Trees, Binary trees simple theorems, and applications. (5-1.1, 5-1.2, 5-1.3, 5-1.4)

Text Books:
SEMESTER – V - GROUP C – APPLICATION ORIENTED SUBJECT A

Subject Title: GRAPH THEORY                        Credit Hours-5

Subject Description:

This course focuses on the Graphs, Sub Graphs, Trees, Planar graphs, Directed graphs. It also deals about matrix representation of Graphs.

Goal:  
To enable the students to understand the basic concepts of Graph Theory.

Objectives:  
On successful completion of this course the students should gain knowledge about Graph Theory.

UNIT I:  

UNIT II:  

UNIT III:  
Matrix representation of a graph – vector spaces, associated with a graph – cycle spaces and act set spaces.

UNIT IV:  
Planar graphs – Enter’s theorem on planar graphs – characterization of planar graphs (no proofs) of the difficult part of the characterization.

UNIT V:  
Directed graphs – Connectivity – Enteoriom Digraphs – Tournaments.

Treatment as in “A First Course in Graph Theory” by A.Chandran (Macmillan) Chapters 1 to 7.

Books for References:

1. Narasingh Deo, “Graph Theory” (Prentice Hall of India).
SEMESTER – V - GROUP C – APPLICATION ORIENTED SUBJECT

Subject Title: RDBMS AND ORACLE *  
No.Of.Hours:5

Subject Description: This paper presents the basic concepts of DBMS, Keys, RDBMS, introduction to SQL, ORACLE data types, Queries in SQL, introduction to PL/SQL, its basic structure, triggers, basic concepts of forms, reports and practical problems.

Goals: To enable the students to learn about the basic concepts of DBMS, RDBMS, SQL, PL/SQL, forms and Reports.

Objectives: On successful completion of the course the students should have learnt the basic concepts of DBMS and RDBMS.
Learn to build a queries using SQL, PL/SQL.
Leant to design a forms and reports using ORACLE Developer 2000.

UNIT –I:

TEXT BOOKS:
For unit 1 treatment as in “Introduction to Database System” –BipinDesai [chapter 1, sections 4.2 and 6.5.1 and 6.5.2]

UNIT II:
Integrative SQL –invoking SQL plus, data manipulation in DBMS ,The ORACLE data types, two dimention matrix creation, Intersection of data into tables, data constrains, computation in expression lists used to select data, logical operation, Range searching, pattern matching, Orac’e function, Grouping data from tables in SQL , Manipulating dates on SQL, joins, sub queries.

UNIT III:
PL/SQL-Introduction, The PL/SQL execution enviornment, the PL/SQL syntax, Understanding the PL/SQL Block structure, database triggers.

UNIT IV:
Working with forms, Basic concepts, Application development in forms, Form module, Blocks items, Canvas view windows, Creating a form Generating and running a form, Using the Layout editor ,Master form, Triggers, Data Navigation Via an Oracle form ,Master detail form, Creating a master detail form, Master detail data entry screen.

UNIT V:
Working with reports ,Defining a data model for report , specific the layout of a report, use the Oracle reports interface, Creating a default tabular report, Creating computed columns, Creating user parameter, Arranging the layout, Creating a Master / Detail report, Creating a matrix report.

TEXT BOOK:
For units 2, 3, 4, 5, treatment as in ‘Commercial application Development using Oracle developer 2000’ by IVAN BAYROSS.
RDBMS PRACTICAL LIST

1. Create a table ‘company’ with the following fields and insert the values for 10 employees.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Name</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Proprietor</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Address</td>
<td>Character</td>
<td>25</td>
</tr>
<tr>
<td>Supplier Name</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>No of employees</td>
<td>Number</td>
<td>4</td>
</tr>
<tr>
<td>GP percent</td>
<td>Number</td>
<td>6 with 2 decimal places</td>
</tr>
</tbody>
</table>

Queries:

a) Display all the records of the company which are in the ascending order of GP percent.

b) Display the detail of the company having the employee ranging from 300 to 1000.

2. Create a table named ‘employee’ with the following field and insert the values.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Name</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Employee code</td>
<td>Character</td>
<td>6</td>
</tr>
<tr>
<td>Address</td>
<td>Character</td>
<td>25</td>
</tr>
<tr>
<td>Designation</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Grade</td>
<td>Character</td>
<td>1</td>
</tr>
<tr>
<td>GP percent</td>
<td>Number</td>
<td>6 with 2 decimal places</td>
</tr>
</tbody>
</table>

Queries:

a) Display the name of the employees whose salary is greater than Rs.10,000

b) Display the details of employees in ascending order according to employee code.

c) Display the total salary of the employees whose grade is “A”.

3. Create a table named “student” with the following fields and insert the values:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Name</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Gender</td>
<td>Character</td>
<td>6</td>
</tr>
<tr>
<td>Roll No</td>
<td>Character</td>
<td>10</td>
</tr>
<tr>
<td>Department Name</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Address</td>
<td>Character</td>
<td>25</td>
</tr>
<tr>
<td>Percentage</td>
<td>Number</td>
<td>4 with 2 decimal places</td>
</tr>
</tbody>
</table>

Queries:

a) Display the names of the students whose percentage is greater than 80.

b) Display the details of the student whose percentage is between 50 and 70.

c) Display the details of the students whose percentage is greater than the percentage of the Roll no =12CA01.

4. Create a table “product” with the following fields and insert the values:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product No</td>
<td>Number</td>
<td>6</td>
</tr>
<tr>
<td>Product Name</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Unit of Measure</td>
<td>Character</td>
<td>15</td>
</tr>
<tr>
<td>Quantity</td>
<td>Number</td>
<td>6 with decimal places</td>
</tr>
<tr>
<td>Total Amount</td>
<td>Number</td>
<td>8 with decimal places</td>
</tr>
</tbody>
</table>
Queries:

a) Using update statements calculate the total amount and then select the record.

b) Calculate the total amount by using sum operation.

c) Calculate the number of records whose unit price is greater than 50 with count operation.

5. Create the table PAYROLL with the following fields and insert the value:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee No</td>
<td>Number</td>
<td>8</td>
</tr>
<tr>
<td>Employee Name</td>
<td>Character</td>
<td>8</td>
</tr>
<tr>
<td>Department</td>
<td>Character</td>
<td>10</td>
</tr>
<tr>
<td>Basic pay</td>
<td>Number</td>
<td>8 with 2 decimal places.</td>
</tr>
<tr>
<td>HRA</td>
<td>Number</td>
<td>6 with 2 decimal places.</td>
</tr>
<tr>
<td>DA</td>
<td>Number</td>
<td>6 with 2 decimal places.</td>
</tr>
<tr>
<td>PF</td>
<td>Number</td>
<td>6 with 2 decimal places.</td>
</tr>
<tr>
<td>Net Pay</td>
<td>Number</td>
<td>8 with 2 decimal places.</td>
</tr>
</tbody>
</table>

Queries:

a) Update the record to calculate the net pay

b) Arrange the records of employees in ascending order of their net pay.

c) Select the details of employees whose HRA >= 1000 and DA <= 900.

d) Display the details of the employee whose department is sales.

6. Create a table publisher and book with the following fields:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publisher Code</td>
<td>Varchar</td>
<td>5</td>
</tr>
<tr>
<td>Publisher Name</td>
<td>Varchar</td>
<td>10</td>
</tr>
<tr>
<td>Publisher City</td>
<td>Varchar</td>
<td>12</td>
</tr>
<tr>
<td>Publisher State</td>
<td>Varchar</td>
<td>10</td>
</tr>
<tr>
<td>Title of book</td>
<td>Varchar</td>
<td>15</td>
</tr>
<tr>
<td>Book Code</td>
<td>Varchar</td>
<td>5</td>
</tr>
<tr>
<td>Book Price</td>
<td>Varchar</td>
<td>5</td>
</tr>
</tbody>
</table>

Queries:

a) Insert the records into the table publisher and book

b) Describe the structure of the tables

c) Show the details of the book with the title ‘DBMS’.

d) Select the book code, book title, publisher city is ‘Delhi’.

e) Find the name of the publisher starting with ‘s’.

7. Create a table Deposit and loan with the following fields:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Field Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account</td>
<td>Varchar</td>
<td>6</td>
</tr>
<tr>
<td>Branch Name</td>
<td>Varchar</td>
<td>15</td>
</tr>
<tr>
<td>Customer Name</td>
<td>Varchar</td>
<td>20</td>
</tr>
</tbody>
</table>
Balance Amount    Varchar                     10
Loan Number        Varchar                     7
Loan Amount        Varchar                      6

Queries:
(a) Insert the records into the table.
(b) Describe the structure of the table
(c) Display the records of Deposit and loan
(d) Find the Maximum loan amount
(e) Arrange the records in descending order of the loan amount

Semester V - Diploma Course
Subject title: Diploma in Operations Research – Paper III - Credit hours: 3

Subject Description:
This course presents applications and method to solve Integer Programming Problems, Non-linear Programming Problems and Dynamic Programming problems. It also includes Markov Analysis and Decision Analysis.

Unit I:
Integer Programming Problem – Gromory’s fractional cut Method – Branch Boud Method.

Unit II:

Unit III:

Unit IV:
Markov Analysis – Stochastic process – Markov analysis Algorithm.

Unit V:

References:
SEMESTER VI - Core Paper – XII

Subject Title: REAL ANALYSIS - II Credit hours: 5

Subject Description: This course presents nature of functions and mappings like continuity, connectivity, and derivative. It also includes the concept of monotonic functions with properties and Riemann - Stieltjes integral.

Goal: To introduce the concepts which provide a strong base to understand and analysis mathematics.

Objective: On successful completion of this course the students should gain the knowledge about the nature of functions mappings.

UNIT I
Examples of continuous functions –continuity and inverse images of open or closed sets –functions continuous on compact sets –Topological mappings –Bolzano’s theorem.

UNIT II
Connectedness –components of a metric space – Uniform continuity: Uniform continuity and compact sets –fixed point theorem for contractions –monotonic functions.

UNIT III

UNIT IV
Properties of monotonic functions –functions of bounded variation –total Variation –additive properties of total variation on (a, x) as a function of x – functions of bounded variation expressed as the difference of increasing functions –continuous functions of bounded variation.

UNIT V

Treatment as in

References
SEMESTER VI  -  Core Paper – XIII

Subject title: COMPLEX ANALYSIS - II  

Credit hours: 6

Subject Description:  This course provides the knowledge about complex functions with some fundamental theorems. Singularity and residues in complex functions, integrations of complex functions and meromorphic functions

Goal:  To enable the students to learn complex number system, complex function and complex integration.

Objectives: On successful completion of this course the students should gained knowledge about the complex functions and its nature.

UNIT I

Results based on Cauchy’s theorem(I) : Zeros-Cauchy’s Inequality – Lioville’s theorem – Fundamental theorem of algebra –Maximum modulus theorem –Gauss mean value theorem – Gauss mean value theorem for a harmonic function on a circle.

UNIT II

Results based on Cauchy’s theorem (II) –Taylor’s series –Laurent’s series.

UNIT III


UNIT IV

Real definite integrals: Evaluation using the calculus of residues – Integration on the unit circle –Integral with \(-\infty\) and \(+\infty\) as lower and upper limits with the following integrals:

i) \(P(x)/Q(x)\) where the degree of \(Q(x)\) exceeds that of \(P(x)\) at least 2.

ii) \((\sin ax).f(x), (\cos ax).f(x), \) where \(a>0\) and \(f(z) \to 0\) as \(z\to\infty\) and \(f(z)\) does not have a pole on the real axis.

iii) \(f(x)\) where \(f(z)\) has a finite number of poles on the real axis.

Integral of the type \(\int_a^b x/(1+x) \, dx; 0< a <1;\)

UNIT V

Meromorphic functions: Theorem on number of zeros minus number of poles –Principle of argument: Rouche’s theorem – Theorem that a function which is meromorphic in the extended plane is a rational function.

Treatment as in


Unit I  Chapter 8  Sections 8.10, 8.11
Unit II  Chapter 9  Sections 9.1 to 9.3, 9.13.
Unit III  Chapter 9  Sections 9.5 to 9.12, 9.13.
Unit IV  Chapter 10  Sections 10.1, 10.2 and 10.4.
Unit V  Chapter 11  Sections 11.1 to 11.3 (Omit theorems 11.5 and 11.6)
References

SEMESTER VI - Core Paper – XIV

Subject title: MODERN ALGEBRA - II
Credit hours: 6

Subject description:
This course provides knowledge about elementary operations on matrices, different types of matrices, rank of a matrix, spaces and linear transformations.

Goals:
It enables the students to understand the concept of matrices and linear transformations.

Objective:
On successful completion of course the students should have concrete knowledge about the elementary operations on matrices, characteristic vector of a square matrix, vector spaces and linear transformations.

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Treatment as in
   Unit I Chapter 1 Sections 1.1 to 1.3, 1.5 to 1.7
   Unit II Chapter 1 Sections 1.8 and 1.9
   Chapter 2 Section 2.9
   Chapter 3 Section 3.9
2. I.N. Herstein, Topics in Algebra, John Wiley & Sons, New York, 2003. (For Units III, IV & V)
Unit III    Chapter 4    Sections 4.1 and 4.2
Unit IV     Chapter 4    Sections 4.3 and 4.4
Unit V      Chapter 6    Sections 6.1, 6.2 and 6.3

References

SEMESTER VI - GROUP C - APPLICATION ORIENTED SUBJECT

Subject Title: ASTRONOMY II                     Credit Hours -5

Subject Description:
This course focuses on the Time, Annual Parallax, Precession, Nutation and The Moon, Eclipses.

Goal: To enable the students to learn about the interesting facts of Moon, Sun Planetary Motion.

Objectives: On successful completion of this course the students should gain knowledge about Astronomy.

UNIT-I:
Time: Equation of time – Conversion of time – Seasons – Calendar.

UNIT-II:
Annual Parallax – Abberation.

UNIT-III:
Precession – Nutation.

UNIT-IV:
The Moon – Eclipses.

UNIT-V:
Planetary Phenomenon – The Stellar system.

Treatment as in “ASTRONOMY” by Mr.S.Kumaravelu and Susheela Kumaravelu.

Question paper setters to confine to the above textbook only.
SEASON VI - GROUP C - APPLICATION ORIENTED SUBJECT
Numerical Methods II

Subject Description:
This course presents Numerical differentiation, Numerical integration and method to solve the differential equations.

Goal:
It exposes the students to study numerical techniques as powerful tool in scientific computing.

Objective:
On successful completion of this course the student gain the knowledge about solving the linear equations numerically and finding interpolation by using difference formulae.

Unit I: Numerical differentiations:
Newton’s forward and backward formulae to compute the derivatives – Derivative using Stirlings formulae – to find maxima and minima of the function given the tabular values.

Unit II: Numerical Integration:
Newton – Cote’s formula – Trapezoidal rule – Simpson’s 1/3rd and 3/8th rules – Glaissian quadrature
– two points and three points formulae

Unit III: Difference Equation:
Order and degree of a difference equation – solving homogeneous and non - homogeneous linear difference equations.

Unit IV:
Taylor series method – Euler’s method – improved and modified Euler method – Runge Kutta method(fourth order Runge Kutta method only)

Unit V: Numerical solution of O.D.E(for first order only):
Milne’s predictor corrector formulae – Adam-Bashforth predictor corrector formulae – solution of ordinary differential equations by finite difference method (for second order O.D.E).

Treatment as in

References:
SEMESTER VI  -  GROUP C  -  APPLICATION ORIENTED SUBJECT

AUTOMATA THEORY AND FORMAL LANGUAGES

UNIT – I
Introduction – phrase structure languages.

UNIT – II
Closure operations.

UNIT – III
Context free languages.

UNIT – IV
Finite state automata.

UNIT – V
Push down automata.

Content and treatment as in, ‘Formal Languages and Automata’ by Rani Sriomoney. Revised edition 1984. Published by the Christian Literary Society, Madras-3 Chapters 1 to 6.

Reference Books:
1. Hopcroft and Stillman-Formal languages and their relation automata-Addision Wesley.

SEMESTER VI  -  GROUP C  -  APPLICATION ORIENTED SUBJECT

Subject Title: PROGRAMMING IN C++ *  No. of Hours: 3

Subject Description: This paper presents the importance of object oriented language, drawbacks of procedure oriented programming, OOPs concepts, class structure, operators, the types of inheritance & polymorphism, Files, Streams and Exception handling & templates.

Goals: To enable the students to learn about the basic OOPs concepts, class structure, operators, inheritance, polymorphism, files, Exception handling and Templates.

Objectives: On successful completion of the course the students should have learnt the drawbacks of Pop and Need for OOP & OOPs concepts
Learnt class structure, member functions & data members.
Learnt the concept of inheritance, types and example problems.
Learnt the concepts of polymorphism, types and problems.
Learnt files, streams and Exception handling & Templates with practical problems.
Reference Books:

UNIT-I:
Evolution of programming languages- -drawbacks of classical methods- need for object orientation – conventional programming versus object oriented programming – properties – treatment of object, class and association of objects.

UNIT-II:

UNIT-III:

UNIT-IV:

UNIT-V:

Text Books:
1. E.Balagurusamy ‘Object Oriented programming with C++’, McGraw Hill
SEMESTER VI - GROUP C - APPLICATION ORIENTED SUBJECT
PROGRAMMING IN C++ PRACTICAL LIST.

1. Create a class to implement the data structure STACK. Write a constructor to initialize the TOP of the stack to 0. Write a member function PUSH(). To insert an element and a member function POP() to delete an element. Check for overflow and underflow conditions.

2. Create a class ARITH which consists of a FLOAT and an INTEGER variable. Write member functions ADD(), SUB(), MUL(), DIV(), MOD() to perform addition, multiplication, division, and modulus respectively. Write member functions to get and display values.

3. Create a class which consist of employee detail ENO, ENAME, DEPT, BASIC SALARY. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade and display the PAY Slip in a neat format using console I/O.

4. Define two classes polar and rectangle to represent points in the polar and rectangle system. Use conversion routines to convert from one system to another.

5. Create a class FLOAT that contains one float data member overload all the four arithmetic operators so that operate on the objects of FLOAT.

SEMESTER VI - GROUP C - APPLICATION ORIENTED SUBJECT
INTERNET AND JAVA PROGRAMMING * No. of credit hours: 3

Subject description:
This paper presents the introduction to internet, ISP, mail, web, URLs, schemes, browser, HTML, Usenet, Gopher, veronica, Jug head, Anonymous ftp, archie, telnet, talk, IRC and muds, Java introduction, data types, operators, statements, class, packages, interfaces, exception handling, threads, applets and AWTS.

Goals:
To enable the students to study about internet, mail, web, HTML, Usenet, Gopher, veronica, Jug head, Archie and Java fundamentals, class, packages, exception handling, threads, applets and AWTS.

Objectives:
On successful completion of the course the students should have:
Learnt the basic concept of internet, mailing, HTML, Archie, telnet, ftp and IRC muds.
Learnt about Java fundamentals, operators and statements.
Learnt the concept of packages, interfaces and exception handling.
Learnt the concept of threads, applets and AWTS.
UNIT I:
Introduction to Internet- Resources of Internet -hardware and software requirements of internet- Internet service providers (ISP)-Internet addressing- Mail Using mail from a shell account - Introduction to web- using the web.

UNIT II:
URLs, schemes host names and port numbers- Using the browser Hypertext and HTML- Using the web from a shell account Introduction to Usenet - Reading and posting Usenet articles- Using Usenet from a shell account- Gopher ,Veronica and Jug head- Using gopher from a shell account.

UNIT III:

UNIT IV:
Features of java - java environment - comparing java with C++ - introduction to java language -types - operators - flow control - classes - packages and interfaces.

UNIT V:
Java classes - string handling- exception handling - threads and synchronization -utilities - input / output - networking - applets - abstract windows toolkit (AWT)-imaging.

Text book:

**COURSE INTERNET AND JAVA PROGRAMMING PRACTICAL LIST**

1. Create web pages using HTML to display ordered and unordered list of a departmental store.
2. Program to display image and text using HTML tag for a advertisement of a company product.
3. Create web pages for a business organization using HTML frames.
4. Create a web site of your department with minimum links using HTML .
5. Create a document using formatting and alignment tags in HTML.
6. Write a Java program to print the triangle of numbers.
7. Write a program which creates and displays a message on the windows.
8. Write a program to draw several shapes in the created window.
9. Write a Java program to accept values and find the given no. is even or odd.
10. Write a Java program to calculate standard deviation.
Semester VI - Diploma Course

SUBJECT TITLE: OPERATION RESEARCH -- Paper IV  CREDIT HOURS: 3

PROJECT AND VIVA-VOCE:
PROJECT AREAS (BROAD FIELD)
1. Linear Programming Problems
2. Transportation Problems.
3. Assignment Problems
4. Inventory Control.
5. Queuing Models
6. PERT
7. Stochastic Process
8. Decision Analysis.

PROJECT : 75 MARKS
VIVA VOCE : 25 MARKS
TOTAL: 100 MARKS
(For Candidates Admitted from 2007-2008)
BSc Degree Examination.
First Semester

PART - III - Mathematics and Maths with CA

CLASSICAL ALGEBRA

Max. Marks: 100

Section A - (10x1 = 10 marks)

1. The coefficient of \( x^7 \) in \((1-x)^{-3}\) is __________

2. The coefficient of \( x^6 \) in the expansion of \( \frac{1+2x-3x^2}{e^x} \) is __________

3. Find the range in which \( \log (1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} \cdots \) is valid.

4. If \( U_n \) and \( V_n \) are two series of positive terms and the second series \( V_n \) convergent then find the condition for \( U_n \) and \( V_n \).

5. \( U_n \) and \( V_n \) are two series of positive terms and the second series \( V_n \) convergent then find the condition for \( U_n \) and \( V_n \).

6. If \( \lim_{n \to \infty} \left( \frac{U_n}{V_n} \right) = 1 \) then find \( U_n \)

7. If \( V_n + V_2 \) is a root of the equation \( x^4 - 14x^2 + 9 = 0 \) then other

roots are __________

8. If \( \alpha, \beta, \gamma, \delta \) be the roots of the biquadratic equation

\( x^4 + px^3 + qx^2 + rx + s = 0 \) then \( \alpha^2 = __________

9. Find the nature of the roots of the equation \( x^5 - 6x^2 - 4x + 5 = 0 \)

\( x^5 - 6x^2 - 4x + 5 = 0 \) has one positive and one negative root.
10. State the formula for Newton's method.

11. (a) Show that \( \sqrt{x^2+16} - \sqrt{x^2+9} = \frac{7}{2x} \) nearly for sufficiently large values of \( x \).

(b) Sum the series
\[
\frac{5}{1!} + \frac{7}{3!} + \frac{9}{5!} + \ldots
\]

(c) Sum the series
\[
\frac{5}{1!} + \frac{7}{3!} + \frac{9}{5!} + \ldots = \sum_{n=1}^{\infty} \frac{2n+3}{(2n-1)!}
\]

12. (a) If \( a, b, c \) denote the three consecutive integers, show that
\[
\log b = \frac{1}{2} \log a + \frac{1}{2} \log c + \frac{1}{2 \cdot a c h} + \frac{1}{3 \cdot (2 a c h)^2} + \ldots
\]

(b) Find whether the series in which \( u_n = \left( \frac{n^3}{n+1} \right)^{\frac{1}{2}} \) converges or diverges.

13. (a) Examine the convergence of the following series
\[
\sum_{n=1}^{\infty} \left( \frac{(n+1) - \sqrt{n^2 + 1}}{n^p} \right)
\]

(b) Examine the convergence of the series
\[
\sum_{n=1}^{\infty} \left( \frac{n}{n+1} \right)^{\frac{1}{2}} \frac{n^p}{n+1}
\]

14. (a) Solve the equation \( 81x^3 - 18x^2 - 36x + 8 = 0 \), whose roots are in H.P.

(b) If the roots of \( x^3 + 3ax^2 + 3bx + c = 0 \) are in H.P then show that \( 2b^3 = c(3ab - c) \).
15. (a) Solve the equation \( x^5 + 11x^4 - 33x^3 - 33x^2 + 11x + 6 = 0 \)

\[ a = 6; b = 11; c = -33; d = -33; e = 11; f = 6 \]

(b) Increase by \( 7 \) the roots of the equation \( 3x + 7x - 15x + x - 2 = 0 \)

\[ 3x + 7x - 15x + x - 2 = 0 \]

**SECTION-C** (5x12 = 60 marks)

16. (a) Find the sum to infinity of the series

\[ \frac{1}{24} - \frac{1.3}{24.32} + \frac{1.3}{24.32.40} - \cdots \]

(b) Sum the series

\[ \sum_{n=1}^{\infty} \frac{n^3 + 3}{n(n+2)^2} \]

17. (a) State and prove Raabe's test

**Rao's Criterion**

(b) Settle the range of values of \( x \) for which the following series converge:

\[ \sum_{n=1}^{\infty} \frac{n^2 \cdot x^n}{1 + x^{2n}} \]

18. (a) Discuss the convergence of the following series:

(i) \( \sum_{n=1}^{\infty} \frac{n^{-1}}{n^p} \) when \( 0 < p < 1 \)

(ii) \( \sum_{n=1}^{n!} \frac{n!}{n^n} \)

(iii) \( \sum_{n=1}^{n!} \frac{1}{n^p} \) when \( 0 < p < 1 \)

(iv) \( \sum_{n=1}^{n!} \frac{1}{n(n \log n)^p} \)

19. (a) Find the condition that the roots of the equation \( a^n + 3bx^n + 3cx + d = 0 \) may be in G.P. Solve the equation \( 27x^3 + 42x^2 - 28x - 8 = 0 \) whose roots are in G.P.
If \( a, b, c \) are the roots of \( x^3 + px^2 + qx + r = 0 \) form the equation whose roots are \( p + y - 2a, y + x - 2b, d + y - 2c \).
\[ x^3 + px^2 + qx + r = 0 \] is the equation. Then \( a, b, c \) are the roots of the equation.

(e) Show that the equation \( x^4 - 3x^3 + 4x^2 - 2x + 1 = 0 \) can be transformed into reciprocal equation by diminishing the roots by unity. Hence solve the equation.

(OR)

(b) Solve the equation \( x^3 - 3x + 1 = 0 \) by Horner's method.
First Semester
Calculus

Time: Three hours Maximum Marks: 100 marks

Answer all questions

SECTION A (10 x 1 = 10 marks)

1. Find the radius of curvature $x^2 + y^2 = 16$ at $(1,1)$ is
   $x^2 + y^2 = 16 \implies \frac{\delta u}{\delta x} + y \frac{\delta u}{\delta y} = \ldots \ldots$ 

2. If $U = x^3 + y^3 + y^2x$ then $\frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \ldots \ldots$

3. $\int \frac{dx}{2x+4} = \ldots \ldots$
   $\int \frac{dx}{2x+4} = \ldots \ldots$

4. Evaluate $\int \log x dx$.
   $\log \frac{\pi}{2}$\ñFй ëè.

5. Evaluate $\int \sin^4 x dx$
   $\pi^2$\ñFй ëè. $\log x dx$.

6. $\int_1^5 \int_2^5 xy dx dy = \ldots \ldots$
   $\int_1^5 \int_2^5 xy dx dy = \ldots \ldots$

7. $\int_0^c \int_b^a \int_0^a dy dx dz = \ldots \ldots$
   $\int_0^c \int_b^a \int_0^a dy dx dz = \ldots \ldots$

8. If $u = x + y, v = x - y$ then $\frac{\partial (u,v)}{\partial (x,y)} = \ldots \ldots$
   $\frac{\partial (u,v)}{\partial (x,y)} = \ldots \ldots$

9. Evaluate $\int_0^{\pi/2} \sin^3 \theta \cos \theta d\theta$
\[ \frac{\sqrt{5}}{2} = \frac{\sqrt{5}}{2} = \]

SECTION B (5 x 6 = 30 marks)

11. (a) Find the radius of curvature of the parabola \( y^2 = 4ax \) at a point.
\[ \frac{\pi}{2} \int_0 \sin^3 \theta \cos \theta d\theta \]

(b) Find the \((p,r)\) equation the curve \( r^2 = a^2 \cos \theta \) and hence find the radius of curvature.
\[ \frac{\pi}{2} \int_0 \sin^3 \theta \cos \theta d\theta \]

12. (a) Evaluate \( \int_{-\alpha}^{\alpha} e^{-x^2} x^3 dx \)
\[ \frac{\pi}{2} \int_0 \sin^3 \theta \cos \theta d\theta \]

(b) Evaluate (i) \( \int_{-\alpha}^{\alpha} e^{-x^2} x^3 dx \) (ii) \( \int x \log(x+1) dx \)
\[ \frac{\pi}{2} \int_0 \sin^3 \theta \cos \theta d\theta \]

13. (a) if \( I_n = \int_0^{\pi/2} x^n \cos x dx \) show that \( I_n + n(n-1)I_{n-2} = \left( \frac{\pi}{2} \right)^n \) and hence find \( \int_0^{\pi/2} x^n \cos x dx \)
\[ \int_0^{\pi/2} x^n \cos x dx \]

(b) Find the area enclosed by the ellipse \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)
\[ \int_0^{\pi/2} x^n \cos x dx \]

14. (a) Change the order of integration in \( \int_{-\alpha}^{\alpha} e^{-x^2} x^3 dx \)
\[ \int_0^{\pi/2} x^n \cos x dx \]

(or)
(b) If \(x+y+z=u,\ y+z=uvw\) then find
\[
\frac{\partial(x, y, z)}{\partial(u, v, w)}
\]
\(\text{â€œè.}
\)

15. (a) Discuss the convergence
\[(i) \int_0^a \frac{dx}{x^2}, a > 0\]
\[(ii) \int_{-\infty}^0 \frac{dx}{(1-3x)^2}\]

(or)

(b) Prove that
\[
\int_{-1}^{1} = \frac{\pi}{2}
\]

SECTON C (5 x 12 = 60 marks)

16. (a) Find the curvature of evaluate of ellipse
\[
\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1
\]

(b)(i) State and prove Euler’s theorem on homogenous function.

(ii) Verify Euler’s theorem when \(u = \sin \left(\frac{x - y}{x + y}\right)^{\frac{1}{2}}\)

(i) \(a^{\frac{1}{2}} \sin \theta \) ïµëëû èñïôåë’èåìèå ãëåêëì ÝÇÎìì î«îÝô¬ìî åë£óëìåë

(ii) \(\sin \left(\frac{x - y}{x + y}\right)^{\frac{1}{2}} \) å¡ëî ëñïôåëòåëïïëëëûëåëëî ÝÇÎìì î«îÝô¬ìî åëKðëì

17. (a) Evaluate
\[(i) \int \frac{dx}{3\cos x + 4\sin x + 6}\]
\[(ii) \int \frac{dx}{x^2 + 6x + 25}\]

(or)

(b) Evaluate
\[(i) \int \sqrt{\frac{x - 2}{5 - x}}\]
\[(ii) \int x^2 \cos x dx\]

(êçèêëåëè. (i)) \(\sqrt{\frac{x - 2}{5 - x}}\) ëçèêëåëè. (ii) \(\int x^2 \cos x dx\)
18. (a) If \( \int_0^{\pi/2} \cos^3 x \cos nx \, dx = f(m,n) \) then \( f(m,n) = \frac{m}{m+n} \) prove that 

\[
f(n,n) = \frac{\pi}{2} \] 

prove that \( f(n,n) = \frac{\pi}{2} \) 

\[
f(n,n) = \frac{\pi}{2n} \] 

\[
hence\ prove\ that\ f(n,n) = \frac{\pi}{2} \] 

\[
f(n,n) = \frac{\pi}{2n} \] 

\[
(\text{or}) \] 

(b) Find the area of the cardioid \( r = a(1+\cos \theta) \) 

\[
r = a(1+\cos \theta) \] 

\[
(\text{or}) \] 

19. (a) Compute \( \int_0^6 \frac{dx}{1+x^2} \) by Simpson's rule taking six intervals. 

\[
A \cdot \hat{e}_i \] 

\[
MF \cdot \hat{d}_j \] 

\[ F \cdot \hat{d} \] 

\[
j \cdot \hat{n} \] 

\[
(\text{or}) \] 

(b) Evaluate \( \int \int \int xyz \, dx \, dy \, dz \) over the positive octant of the sphere \( x^2 + y^2 + z^2 = a^2 \) by transforming onto spherical coordinates. 

20. (a) Prove that (i) \( \sqrt{(n+1)} = n!, n > 0 \) (ii) Evaluate \( \int_0^{\infty} e^{-x^2} \, dx \) 

\[
(\text{i}) \] 

\[
G \hat{a} \] 

\[
(\text{ii}) \] 

\[
n \hat{F} \hat{S} \hat{I} \hat{e} \] 

\[
(\text{or}) \] 

(b) Prove that \( \beta(m,n) = \frac{\sqrt{m} \sqrt{n}}{\sqrt{m+n}} \) 

\[
G \hat{a} \] 

\[
(\text{or}) \] 

Time: 3 Hrs 

ANALYTICAL GEOMETRY 

SECTION –A (10X1=10 MARKS) 

1. Write the equation of the Normal to the conic at \( \alpha' \) 

\[
\alpha' \hat{a} \hat{c} \hat{d} \hat{f} \] 

\[
(\text{or}) \] 

2. The polar equation of a conic is \[
(\text{or}) \] 

\[ a) \] 

\[ b) \] 

\[ c) \] 

\[ d) \] 

\[ e) \] 

\[ f) \] 

\[ g) \] 

\[ h) \] 

\[ i) \] 

\[ j) \] 

\[ k) \] 

\[ l) \] 

\[ m) \] 

\[ n) \] 

\[ o) \] 

\[ p) \] 

\[ q) \] 

\[ r) \] 

\[ s) \] 

\[ t) \] 

\[ u) \] 

\[ v) \] 

\[ w) \] 

\[ x) \] 

\[ y) \] 

\[ z) \] 

3. The angle between the straight line having the d.c's \( (l_1m_1n_1) \) and \( (l_2m_2n_2) \) is
a) \( \cos \theta = l_1 l_2 + m_1 m_2 + n_1 n_2 \)
b) \( \sin \theta = l_1 l_2 + m_1 m_2 + n_1 n_2 \)
d) \( \cos \theta = l_1 l_2 + m_1 m_2 - n_1 n_2 \)

c) \( \sin \theta = l_1 l_2 + m_1 m_2 + n_1 n_2 \)

d. c's \( (l_1, m_1, n_1) \) and \( (l_2, m_2, n_2) \) satisfy \( z = l_1 z_1 + m_1 z_2 + n_1 z_3 \).

4. The Lines \( \frac{x-2}{-4} = \frac{y-3}{3k} = \frac{z-4}{2} \) and \( \frac{x-3}{4k} = \frac{y-4}{2} = \frac{z-7}{-3} \) are perpendicular. Find the value of \( k \).

5. Find the centre of the sphere \( 4x^2 + 4y^2 + 4z^2 - 8x + 1by + 24z + 45 = 0 \).

6. Find the equation of the sphere having \((1, -2, 3)\) and \((3, -4, 5)\) as ends of diameter.

7. If the cone \( ax^2 + by^2 + cz^2 + 2fyz + 2yzx + 2hxy + 24x + 2vy + 2wz = 0 \) has mutually perpendicular generators, then find the condition.

8. Write the equation of the right circular cylinder whose axis is the z-axis and radius 'a'.

9. Write the general equation of the ellipsoid.

10. Write the general equation of the hyperboloid of the sheet.

SECTION –B (5X6=30 MARKS)

11.(a) Derive the equation of the asymptotes if the conic \( l/r = 1 + e \cos \theta \).

(b) Derive the polar equation of a curve in \( l/r = 1 + e \cos \theta \).

12.(a) Find the equation of the line through \((-1, 4, 6)\) and parallel to the line \( x-y+2z=5, 3x+y+z=6 \).

(b) Obtain a symmetrical form of the equation \( 2x-2y-z=2, x+2y+2z=4 \) of a straight line.

13.(a) Find the equation of the sphere with centre \((1,2,3)\) and touch the plane \( x+y+2z=1 \).
(or)
(b) Find the equation of the sphere passing through the points (2,0,1) (1,-5,1), (0,-2,3) & (4,-1,2).
\[(2,0,1) \text{ (1,-5,1), (0,-2,3) & (4,-1,2)} \pm yE \hat{Ou} \hat{C}e \hat{u} \hat{A} \hat{V} \hat{E} \hat{c} \hat{I} \hat{o} \hat{O} \hat{o} \hat{s} \hat{l} \hat{i} \hat{C} \hat{o} \hat{e} \hat{y} \hat{A} \hat{y} \hat{A} \hat{j} \hat{d} \hat{o} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

14.(a) Find the equation of the right circular cone whose vertex in the origin axis in
the line \(x/1 = y/2 = z/3\) and semi vertical angle is \(30^0\).
\[-\hat{A} \hat{O} \hat{O} \hat{D} \hat{A} \hat{o} ^{\frac{1}{4}} \hat{C} \hat{A} \hat{C} \hat{e} ^{y} \text{ "i} \text{ } x/1 = y/2 = z/3 \pm yA \hat{A} \hat{d} ^{\frac{1}{4}} \hat{A} \hat{l} \hat{i} \hat{o} \hat{O} \hat{d} ^{\frac{1}{4}} \hat{A} \hat{l} \hat{i} \hat{n} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{A} \hat{l} \hat{i} \hat{n}.
\]

(b) Find the equation of the right circular cylinder whose axis \(x-1/2 = y/3 = z-3/1\) and radius 2.
\[\hat{O} \hat{s} \hat{l} \hat{e} \hat{D} \hat{u} \hat{C} \hat{D} \pm yE \hat{O} \hat{D} \hat{l} \hat{o} \hat{D} \hat{O} \hat{O} \hat{C} \hat{e} \hat{y} \hat{A} \hat{y} \hat{A} \hat{j} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

15.(a) Find the director sphere of the conic coid \((x^2/a^2) + (y^2/b^2) + (z^2/c^2) = 1\) (or)
(b) Tangent planes are drawn to \((x^2/a^2) + (y^2/b^2) + (z^2/c^2) = 1\) through fixed point \((\alpha,\beta,\nu).\) Prove that origin generate the cone. \((\alpha x+\beta y+\nu z)^2 = a^2 x^2 + b^2 y^2 + c^2 z^2\)

SECTION-C (5X 12= 60)

16 (a) Derive the equation of the tangent at \(‘\alpha’\) to the conic \(l/r = 1+e \cos \theta.\)
\[l/r = 1+e \cos \theta \pm yE \hat{O} \hat{u} \hat{o} \hat{d} \hat{E} \hat{A} \hat{c} \hat{y} \hat{s} \hat{\alpha} \hat{o} \quad \text{‘}\alpha \text{’-e} \quad \text{‘}\beta \text{’} \quad \text{‘}\nu \text{’} \quad \text{‘}\hat{A} \hat{y} \hat{A} \hat{j} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

(b) Find the equation of normal at \(‘\alpha’\) on the conic \(l/r = 1+e \cos \theta.\)
\[l/r = 1+e \cos \theta \pm yE \hat{O} \hat{u} \hat{o} \hat{d} \hat{E} \hat{A} \hat{c} \hat{y} \hat{s} \hat{\alpha} \hat{o} \quad \text{‘}\alpha \text{’-e} \quad \text{‘}\beta \text{’} \quad \text{‘}\nu \text{’} \quad \text{‘}\hat{A} \hat{y} \hat{A} \hat{j} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

17 (a) Show that the line \(x-1/2 = y-2/-1 = z+6/-3\) and \(x+2y+z+2 = 0, 4x+ 5y+3z+6=0\) are
coplanar and find the point of intersection and the plane of coplanarity.
\[x-1/2 = y-2/-1 = z+6/-3 \text{ and } x+2y+z+2 = 0, 4x+ 5y+3z+6=0 \pm yE \text{ pO} \quad \text{‘}\hat{A} \hat{y} \hat{A} \hat{j} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

(b) Find the length and the equation of the shortest distance between the lines \(x-3/-1 = y-4/2 = z+2/1\) and \(x-1/1 = y+7/3 = z+2/2.\)
\[x-3/-1 = y-4/2 = z+2/1 \text{ and } x-1/1 = y+7/3 = z+2/2 \quad \text{‘}\hat{A} \hat{y} \hat{A} \hat{j} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

18 (a) Show that the plane \(2x-2y+z+12 = 0\) touch the sphere
\[x^2 + y^2 + z^2 = 4y+2z-3=0 \text{ and } \text{find the point of contact}.
\]
\[2x-2y+z+12 = 0 \pm yE \quad \text{‘}\hat{A} \hat{y} \hat{A} \hat{j} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

(b) Obtain the equation of the sphere having the circle \(x^2 + y^2 + z^2 = 10y-4z-8=0,\)
\[x+y+z = 3 \text{ as a great circle}.
\]
\[x^2 + y^2 + z^2 = 10y-4z-8=0, \quad x+y+z = 3 \pm yE \quad \text{‘}\hat{A} \hat{y} \hat{A} \hat{j} \hat{o} \hat{d} ^{\frac{1}{4}} \hat{i} \hat{n}.
\]

19(a) Find the equation of the cone whose vertex \((x,y,z)\) which envelops the sphere
\[S = x^2 + y^2 + z^2 - a^2 = 0.
\]
(x,y,z) \pm \hat{u} \hat{v} \hat{w}^\perp \hat{A} \hat{B} i_1, j_1, k_1 \iff x^2 + y^2 + z^2 - a^2 = 0 \pm \hat{u} \hat{v} \hat{w}^\perp \hat{A} \hat{B} \hat{C} \hat{D} \hat{E} \hat{F} \hat{G} \hat{H} i_1, j_1, k_1.

(or)

(b) Find the equation of the right circular cylinder whose guiding curve in the circle
\[ x^2 + y^2 + z^2 = 4, \quad x+y+z = 2. \]
\[ x^2 + y^2 + z^2 - 4, \quad x+y+z = 2 \pm y \hat{E} \hat{A} \hat{B} i_1, j_1, k_1 \iff x^2 + y^2 + z^2 - 4 \hat{C} \hat{D} \hat{E} \hat{F} \hat{G} \hat{H} i_1, j_1, k_1. \]

20 (a) Find the locus of the point of intersection and three mutually perpendicular tangent plane to the central conic
\[ ax^2 + by^2 + cz^2 = 1. \]
\[ ax^2 + by^2 + cz^2 = 1, \quad x+y+z = 2 \pm y \hat{E} \hat{A} \hat{B} i_1, j_1, k_1 \iff ax^2 + by^2 + cz^2 = 1 \hat{C} \hat{D} \hat{E} \hat{F} \hat{G} \hat{H} i_1, j_1, k_1.

(or)

(b) Find the equation of the tangent plane of the ellipsoid
\[ \left( \frac{x^2}{6} + \frac{y^2}{3} + \frac{z^2}{2} \right) = 1 \]
which intersect in the line
\[ \frac{x}{3} = \frac{y-3}{-3} = \frac{z}{1}. \]
Find also the co-ordinate of the point of contact.
\[ \frac{x}{3} = \frac{y-3}{-3} = \frac{z}{1} = z/1. \quad \text{Find also the co-ordinate of the point of contact.} \]
\[ x^2/3 - 3 = z/1 \pm y \hat{E} \hat{A} \hat{B} i_1, j_1, k_1 \iff x^2/3 - 3 = z/1 \hat{C} \hat{D} \hat{E} \hat{F} \hat{G} \hat{H} i_1, j_1, k_1. \]

TRIGONOMETRY AND VECTOR CALCULUS

Time: 3 Hrs
Maximum: 100 Marks

ANSWER ALL QUESTIONS

SECTION A (10X1=10 MARKS)

1. Write the expansion of \( \cos n \theta \)
\[ \cos n \theta = \cos \theta \cdot \text{trigonometric function} \]

2. Write the expansion of \( \sin n \theta \)
\[ \sin n \theta = \sin \theta \cdot \text{trigonometric function} \]

3. \( \log i = \log i \cdot \text{function} \)

4. Find \( \log (-e) \)
\[ \log (-e) \cdot \text{function} \]

5. A function F is said to be harmonic if
\[ (a) \ \nabla F = 0 \quad (b) \ \nabla \times F = 0 \quad (c) \ \nabla^2 F = 0 \quad (d) \ \Delta F = 0 \]
\[ F \ \text{is harmonic} \iff \nabla \times F = 0; \ \text{trivial function} \]

6. \( \text{Find the value of } \text{div} (\text{curl } F) \)
\[ \text{div} (\text{curl } F) = \text{function} \]

7. Write the formula for work done by the force of a vector \( F \)
\[ F \text{ is work done} \iff \text{function} \]

8. F is called conservation field is
\[ (a) \ F = \nabla \phi \quad (b) \ F = \nabla \phi \quad (c) \ F = \nabla \phi \cdot d \quad \nabla = 0 \]
\[ F \text{ is conservation field} \iff \nabla \phi = 0; \ \text{trivial function} \]

9. If \( f(x) = e^x \) then find the value of \( a_0 \) in \[ 0, 2\pi \]
\[ f(x) = e^x \cdot \text{function} \; [0, 2\pi]; \quad y; \quad a_0 = \text{function} \]

10. The period which is valid for writing half range series is
(a) 0 (b) 2π (c) π (d) None of these.
xU rhHig /g+hpah miutPr;Rj; njhlhpv; vojj;jUJ ngw; fhyl;l;lk;
(m) 0 (M) 2π (,) π (<) None of these.

SECTION –B (5X6=30)

11. (a) Express Sin5θ interms of Sinθ.
(m) Sin5θ -d; tptid Sinθ - tpy; vOjf.
(or)
(b) If tanθ / θ = 2524 / 2523 . Show that θ is approximately equal to 1° 58′.
(M) tanθ / θ = 2524 / 2523 vdp; θ-td; kjpg;G Njuhakhf 1° 58′;F rkk; vd epWTf

12. (a) Express (-2) in a+ib form.
(m) (-2) a+ib mikg; gpy; vOJ
(or)
(b) S.T Log (1+ e^iα) = Log (2 cos α/2) + iα/2.
(M) Log (1+ e^iα) = Log (2 cos α/2) + iα/2 vd ep&gp.

13. (a) Prove that div(gradF) = ∇^2 F
(m) div(gradF) = ∇^2 F vd epWTf.
(or)
(b) P.T. curl (φ f) = φ (∇Xf) + (∇φ) X f .
(M) curl (φ f) = φ (∇Xf) + (∇φ) X f

14. (a) Obtain ∫ A dr whose A = Zi + xj + yt . and C is the arc of the curve r= costi + sinti + tk from
(m) ∫ A dr d; kjpg;G fhz;f. ,q;F A = Zi + xj + yt C vd;gJ t=0 tpy; t=2π tiuapy; r=costi + sinti + tk vd;w tistiuplicy; tpy;ypad; epSk; fhz;f.
(or)
(b) Find the work done by the force F= 3x^2 i+ 2yzj –z^2 k in moving a particle along
the curve x=2t, y= t^2 and z=t from t=0 tp t=2.
(M) t=0 tpypUe;J t=2 tiu x=2t, y= t^2 and z=t vd;w tistiupd; kPJ Jfs; efUtjw;F nrYj;jg;gl;l tpir F= 3x^2 i+ 2yzj –z^2 vd;w ntf;luhy; nra;ag;gl;l Ntiyiaf; fhz;f.

15 (a) Obtain the Fourier series for f(x) =x, -π<x<π
(m) for f(x) =x, -π<x<π l /g+hpaH njhlp; fhz;f.
(or)
(b) Obtain the half range Cosine series for f(x) = x in 0<x<π
(M) 0<x<π f(x) = x l /g+hpaH nhfird; njhlp; fhz;f.

SECTION C (5X12=60)

16 (a) Prove that 2^6 cos^7 θ = cos7θ + 7 cos5θ +21 cos3θ + 35 cosθ.
(m) 2^6 cos^7 θ = cos7θ + 7 cos5θ +21 cos3θ + 35 cosθ vd epWTf
(or)
(b) Expand Cos^4θ Sin^3 θ
(M) Cos^4θ Sin^3 θ – l tphpTgJLj; Jf.

17 (a) Sum the series Sinα + Sin (α+β)+Sin (α+2β)+…..to n terms. (or)
(m) Sinα + Sin (α+β)+Sin (α+2β)+…..to n cWg;Gtiu $Ljy; fhz;f.
(or)
(b) Sum to infinity the series : \(1 + e^2 \cos 2\theta/2! + e^4 \cos 4\theta/4! + \ldots\).
(M) \(1 + e^2 \cos 2\theta/2! + e^4 \cos 4\theta/4! + \ldots\).

18 (a) Prove that
\[\nabla X(\nabla X f) = \nabla (\nabla f) - \nabla^2 f.\]
(m) \(\nabla X(\nabla X f) = \nabla (\nabla f) - \nabla^2 f\) epWTf.

(or)

(b) P.T
\[F = (3x^2 + 2y^2 +1)i+ (4xy-3y^2z-3)j + (z-y^3)k \text{ is irrational.}\]
(M) \(F = (3x^2 + 2y^2 +1)i+ (4xy-3y^2z-3)j + (z-y^3)k\) vd; w ntf; lH Royw; W vd epWTf.

19. (a) Using Gauss theorem find the value of \(\int F \cdot n \, ds\). Where \(F= xy^2i + yz^2j + zx^2k\) and \(S\) is the closed surface banded by the planes \(x=0, x=1, y=0, y=2 z=0 & z=3\).
(m) \(\int F \cdot n \, ds\) d; kjpg; G \(F= xy^2i + yz^2j + zx^2k,\) S vd; gJ x=0, x=1, y=0, y=2 z=0 & z=3 vd; w jsq; fshy; %lg; gl;l Nkw; gug; G.

(or)

(b) Evaluate \(\int f \, dv\) for the vector \(f = xi + yj + zk\) whose \(V\) is the regions bounded by the surface \(x=0, x=2, y=0, y=6, z= 4 & z= x^2\).
(M) \(\int f \, dv\) d; kjpg; G fhz; f. \(Mfpa jsq; fs; milgLk; gFjpahFk; .\)

20. (a) Obtain the Fourier series for \(f(x) = x^2\) where \(-\pi < x < \pi\) and deduce that
\[1/ 1^2 + 1/ 2^2 + 1/ 3^2 + \ldots = \pi^2 / 6.\]
(m) \(-\pi < x < \pi\) vd; w ,ilnts papy; \(f(x) = x^2\) vd; w rhHgp; G+hpaH njhliuf; fhz; f.
mjypUe; J 1/ 1^2 + 1/ 2^2 + 1/ 3^2 + \ldots = \pi^2 / 6.\) vd epWTf.

(or)

(b) If \(f(x) = -x\) if \(-\pi < x < 0\)
\[x \text{ if } 0 \leq x \leq \pi\]
Expand \(f(x)\) as a Fourier series in the interval \((-\pi, \pi)\).
DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Time: 3 Hrs
Maximum: 100 Marks

SECTION –A (10X1=10 MARKS)

ANSWER ALL QUESTIONS

1. Find the general solution of y-px = a/p.
   y-px = a/p - d; nghJ jPHit fhz;f.

2. Find the solution of \( p^2 - 4p - 12 = 0 \)
   \( p^2 - 4p - 12 = 0 \) vd; w rkd; ghl; bd; jPHT fhz;f.

3. Find the solution \( (D^3 - D) y = 0 \)
   \( (D^3 - D) y = 0 \) d; jPHT fhz;f.

4. If \( x^2 + p^2 \) then find \( 1/p \).
   \( x^2 + p^2 \) vdpy; \( 1/p \) fhz;f.

5. The elimination of arbitrary constants h.k from \( (x-h)^2 + (y-k) + z^2 = a^2 \).
   Is \( (x-h)^2 + (y-k) + z^2 = a^2 \) vd; gpy; h.k vd; w nghJ thd khpypia ePf; fp fpilg; gJ

6. Find the auxiliary equation of \( Pp + Qq = R \)
   \( Pp + Qq = R \) vd; gjp; Jiz rkd; ghl; ilf; fhz;f.

7. \( L \{ e^{-at} \} = \)
   \( L \{ e^{-at} \} = \)

8. \( L \{ t e^{t} \} = \)
   \( L \{ t e^{t} \} = \)

9. Find \( L^{-1} \left( \frac{1}{S^2} \right) \)
   \( L^{-1} (1/ S^2) \) -apidf; fhz;f.

10. Find \( L^{-1} \left( \frac{S}{S^2 + 9} \right) \)
    \( L^{-1} (S/ S^2 + 9) \) -apidf; fhz;f.

SECTION-B ( 5X6= 30)

11. (a) Solve : \( p^2 - 5p + 6 = 0 \), \( p = dy/dx \).
    \( m \) jPHf; f : \( p^2 - 5p + 6 = 0 \), \( p = dy/dx \).
    (or)

   (b) Solve : \( dx / z(x+y) = dy / z(x-y) = dz / x^2 + y^2 \).
   \( m \) jPHf; f : \( dx / z(x+y) = dy / z(x-y) = dz / x^2 + y^2 \).

12. (a) Solve \( (D^2 - 4D + 13)y = e^{2x} \cos 3x \).
    \( m \) jPHf; f : \( (D^2 - 4D + 13)y = e^{2x} \cos 3x \).
    (or)

   (b) Find the particular integral of \( (D^2 + 5D + 6)y = x^2 e^{-x} \).
   \( m \) (\( D^2 + 5D + 6)y = x^2 e^{-x} - d \) rpwg; G njhif fhz;f.

13. (a) Form the partial differential equation by eliminating a and b from \( (x-a)^2 + (y-b)^2 + z^2 = 1 \).
    \( m \) \( (x-a)^2 + (y-b)^2 + z^2 = 1 \) ypUe; J a kw; Wk; b Mfpaw; iw ePf; Ftjd; %yk; gFjp tiff; nfO rkd; ghl; il cUthf; Ff.
    (or)

   (b) Solve : \( q - p + x - y = 0 \)
   \( m \) jPHf; f : \( q - p + x - y = 0 \)

14. (a) Find \( L(\sin 3t \sin 2t) \)
    \( m \) \( L(\sin 3t \sin 2t) \) – iaf; fhz;f.
(or)
(b) Find $L\left( e^{-2t} \cos ht \right)$
(m) $L\left( e^{-2t} \cos ht \right) - \text{iaf}; \text{fhz};f.$
15. (a) Find $L^{-1} \left[ \frac{1}{S(S+3)} \right]$ (or)
(m) $L^{-1} \left[ \frac{1}{S(S+3)} \right] - \text{iaf}; \text{fhz};f.$
(or)
(b) Find $L^{-1} \left[ \frac{S}{(S+2)^2} \right]$
(M) $L^{-1} \left[ \frac{S}{(S+2)^2} \right] - \text{iaf}; \text{fhz};f.$

SECTION – C (5X12 = 60)
16. (a) Solve $(dx/dt) + 4x + 3y = t, (dy/dt) + 2x + 5y = e^t$ (or)
(m) $jPHf;f : (dx/dt) + 4x + 3y = t, (dy/dt) + 2x + 5y = e^t.$
(or)
(b) Solve $p^3 - 4xyz + 8y^2 = 0.$
(M) $jPHf;f : p^3 - 4xyz + 8y^2 = 0.$
17. (a) Solve $x^2 \left( \frac{d^2y}{dx^2} \right) - 3x \left( \frac{dy}{dx} \right) + 5y = x^2 \sin (\log x)$ (or)
(m) $jPHf;f : x^2 \left( \frac{d^2y}{dx^2} \right) - 3x \left( \frac{dy}{dx} \right) + 5y = x^2 \sin (\log x)$
(or)
(b) Solve $\left( (D^3 - 3D^2 + 3D - 1) y \right) = e^x x^2$
(M) $jPHf;f : \left( (D^3 - 3D^2 + 3D - 1) y \right) = e^x x^2$
18. (a) Solve $z = px + qy + \sqrt{1 + p^2 + q^2}$ (or)
(m) $jPHf;f : z = px + qy + \sqrt{1 + p^2 + q^2}.$
(or)
(b) Solve $9 \left( p^2 z + q^2 \right) = 4$
(M) $jPHf;f : 9 \left( p^2 z + q^2 \right) = 4.$
19. (a) If $L\{ f(t) \} = f(s)$ then prove that $L\{ t^n f(t) \} = \left( -1 \right)^n \frac{d^n}{ds^n} f(s).$ (or)
(m) $L\{ f(t) \} = f(s) \text{Mdhy}; L\{ t^n f(t) \} = \left( -1 \right)^n \frac{d^n}{ds^n} f(s) \text{vd epWTf}.$
(or)
(b) Evaluate:
(i) $L\{ t^2 \cos 3t \}$
(ii) $L\{ t^2 e^t \sin t \}$
(M) $kjpg;G \text{fhz};f :$
(i) $L\{ t^2 \cos 3t \}$
(ii) $L\{ t^2 e^t \sin t \}$
20. (a) Using Laplace transform: Solve $(D^2 + 4D + 13)y = 2 e^x$ given that $y(0) = 0, y' (0) = -1$ (or)
(m) $yhg;yh]; \ cUkhw;wj;ij \ gad;gLj;jp \ jPHf;f : (D^2 + 4D + 13)y = 2 e^x \text{NkYk};$
$y(0) = 0, y' (0) = -1.$
(or)
(b) Using Laplace transform, Solve: $(d^2y/ dx^2) - 3(dy/dx) + 2y = 4, y(0) = 2, y' (0) = 3.$
(M) $yhg;yh]; \ cUkhw;wj;ij \ gad;gLj;jp \ jPHf;f : (d^2y/ dx^2) - 3(dy/dx) + 2y = 4, y(0) = 2,$
$y' (0) = 3.$
STATICS

Time : 3 hours Maximum : 100 Marks

Answer all questions.

SECTION – A (10 x 1 = 10 Marks)

1. IF forces acting at a point are equilibrium then find their resultant.
   \( \sum \mathbf{F} = \mathbf{0} \)
   \( \mathbf{R} = \mathbf{F_1} + \mathbf{F_2} + \ldots + \mathbf{F_n} \)

2. In \( (\lambda - \mu) \) theorem, \( \lambda \overrightarrow{OA} + \mu \overrightarrow{OB} = \) __________

3. Find the moment of the force \( F \) about \( O \)

4. If \( \mathbf{P} = \mathbf{P_1} + \mathbf{P_2} \) then find its moment.
   \( \mathbf{M} = \mathbf{P_1} \times \mathbf{r_1} + \mathbf{P_2} \times \mathbf{r_2} \)

5. The equation of the line of action of the resultant of system of coplanar force is
   \( \mathbf{R} = \mathbf{F_1} + \mathbf{F_2} + \ldots + \mathbf{F_n} \)
   \( \mathbf{R} = \mathbf{F_1} \times \mathbf{r_1} + \mathbf{F_2} \times \mathbf{r_2} + \ldots + \mathbf{F_n} \times \mathbf{r_n} \)

6. If the algebraic sum of the moments of the forces about any point in their plane is zero then __________
   \( \sum \mathbf{M} = 0 \)

7. If \( \lambda \) the coefficient of friction than \( \mu = \) ______________
   \( \mu = \tan \theta \)

8. Write the semi vertical angle of the cone of friction.
   \( \theta = \tan^{-1} \mu \)

9. Write the intrinsic equation of the centenary
   \( r = \rho + \phi \)

10. If \( l \) is length of chain and the tension at \( A \) is twice that the lowest point than \( C \mu = \) ______________

SECTION – B (5x6 = 30 Marks)

11 (a). State and prove triangle law of forces.
   \( \mathbf{R} = \mathbf{F_1} + \mathbf{F_2} + \mathbf{F_3} \)

(b). Find the resultant of any number of coplanar forces acting at a point
   \( \mathbf{R} = \mathbf{F_1} + \mathbf{F_2} + \ldots + \mathbf{F_n} \)

12. (a) State and prove the fundamental theorem on coplanar couples.

(b) \( P \) and \( Q \) are two like parallel forces acting at \( A \) and \( B \) respectively. Prove that if they interchange position the point of application of the resultant in displacement through a distance \( P-Q/P+Q.AB \) along \( AB \).
(M) P,Q vd;gd A,B vd; w Gs;spfspy; KiwNa ,aq;Fk; xj;j miz tpirs; vdpy; mit xd;Wf;nfhd;W ,lkhw;wk; nra;ag;gl;thy; mtw;wpd; tpisT tpir AB – d; jpirapy; P-Q/P+Q. AB Jjuk; ,lk; ngaUk; vd epWTf.
13 (a). Obtain the equation to the line of action of the resultant of a system of coplanar forces.
(m) xU js tpirs; tpisT tpirapd; NfhL jpirapd; rkd;ghL fhz;f.
(or)

(b) Prove that if three coplanar forces acting on a rigid body keep it in equilibrium, they must be either concurrent or parallel
(M) xU fl;b Jf;fg; nghUs; kPJ ,aq;Fk; %d;W xU js tpirs; mjid xa;T epiyapy; itj;jpUe;jhH. mt;tpirfs; xU Gs;sp top nray;gLItahfNth my;yJ ,izahfNth ,Uf;Fk; vd epWTf.
14. (a) Obtain the condition of equilibrium of three coplanar parallel forces.
(m) xU jsj;jpy; nray;gLk; miz tpirs; rkepiyapy; ,Ug;gjw;fhd epe;jidia jUtpf;f.
(or)

(b) A uniform ladder is in equilibrium with one end resting on the ground and the other against a vertical wall. If the ground and the wall be both rough, the coefficient of friction being $\mu$ and $\mu'$ respectively, and if the ladder be on the point of slipping at both ends.
Show that $\theta$, the inclination of the ladder to the horizontals is given by tan $\theta = 1-\frac{\mu}{\mu'}$.
(M) Vzp mj; xU Vzp> jiuapd; kPJk; kw;nwhU Vzp nrq;Fj;jhd Rthpd; kPJk; ,Uf;f rkepiyapy; cs;SJ. jiu kw;Wk; RtW;wpf; cuha;T nfof;fs; KiwNa $\mu$, $\mu'$ vdp; ,U KdfspYk; tOf;Fk; epiyapy; ,Uf;Fk; NhJ fpil kl;lj;Jld; mJ cz;lhf;Fk; tan $\theta = 1-\frac{\mu}{\mu'}$ vd epWTf.
15 (a) Find the C.G of a uniform solid semishpex
(m) xU rPuhd nfl;b miu Nhhsj;jpd; Gtp <Hg;G ikak;
(or)

(b) Derive the intrinsic equation of the catenary.
(M) xU rq;fpypaj;jpd; cs;spay;G rkd;ghl;ilj; jUtpf;f.

SECTION – C ( 5x12=60 marks)
16 (a) State and prove Lami’s theorem
(m) yhkp]; Njw;wj;ij $wp epWTf.
(or)

(b) ABC is a given triangle. Forces P,Q,R acting at the point O along the lines OA,OB,OC are in equilibrium. Prove that P:Q:R=$a^2(b^2+c^2-a^2):b^2(c^2+a^2-b^2):c^2(a^2+b^2-c^2)$ if O is the circum centre of $\triangle$ ABC.
(M) ABC vd;gJ XH Kf;Nhzhk; 0 vd;w Gs;spay; OA,OB,OC vd;w jpirfs; rpkepiyapy; ,Ug;gpd; 0 vd;gJ $\triangle$ ABC -d; Rw;W tl;l ikanpdpy; P:Q:R=$a^2(b^2+c^2-a^2):b^2(c^2+a^2-b^2):c^2(a^2+b^2-c^2)$ if
17 (a) Find the resultant of two like parallel forces. Also find its position.
(m) ,U xj;j ,iztpirfs; tpisT tpiraf; fhz;f. NkYk; mit nray;gLk; ,lj;ij fhz;f.
(or)

(b) Prove that if two couples whose moments are equal and opposite acting the same plane rigid body they balance one another.
(m)l;bWf;fg;gl;l nghUs; kPJ ,U Rkypdfsp; jpUg;Gj;jpdw; rkk; NkYk; mit vjPH jsq;fsp; vpuhf nray;glfwpW vdpy; mit xd;iwnahd;W rkd; nra;Ak; vd ep8gp.
18 (a) Obtain the necessary and sufficient condition that a system of coplanar forces acting on a rigid body may be in equilibrium.
(M) nfhLjp rkepiyapy; ,Ug;gjw;fhd Njitahd kw;Wk; NghJkhd epge;jidia jUf.

(or)

(b) Prove that if a system of forces act on a rigid body and if the algebraic sum of their moment, about each of three non collinear point is zero separately the system of forces will be in equilibrium.

(M) njhfjpapd; jpUg;Gj;jpwd;> xU Nfhl;byikahj %d;W Gs;spfis nghWj;J jdpj;jdpNa G+[,pak; vdpy; tpir njhFjp rkepiyapy; ,Uf;Fk; vd epWTf.

19 (a) A body is at root on a rough plane inclined to the horigen at an angle greater than the angle of friction and is acted upon a force parallel to the plane and along the line of greatest slope, then show that P lies between \( \omega \sin(\alpha - \lambda) / \cos(\lambda) \) and \( \omega \sin(\alpha + \lambda) / \cos(\lambda) \)

(m) cuha;T Nfhzj;jpw;F mjpfkhd xU Nfhzr; rha;tpYs;s xU rha;G jsj;jpy; Nky; xU nghUs; itf;fg;gL Mjd; Nky; rha; jsj;jpw;f mizahd jpirapy; vd;Dk; tpir nray;gL nghUsr rkepiyapy; itj;jpUf;Fkhapd; P-d; kjpg;G \( \omega \sin(\alpha - \lambda) / \cos(\lambda) \) f;Fk; \( \omega \sin(\alpha + \lambda) / \cos(\lambda) \) f;Fk; ,ilapy; ,Uf;Fk; vd epWTf.

(or)

(b) A square lamina whose plane is vertical rests in the ends of side against a rough vertical wall and a rough horizontal ground. If the coefficients of friction for the ground and the wall be \( \mu \) and \( \mu' \) respectively. Prove that when the lamina is on the point A motion, the inclination of the side in question to the horizontal in \( \tan^{-1}(1 - \mu' / 1 + 2\mu + \mu') \)

(M) xU rJu jfL epiyGj;jjhf mjd; xU gf;fj;jpd; xU Kid xU nhunhug; ghd ,il jsj;jpYk; kw;nhU Kid epiyf; ve;jr; Rtw;wpY; K;bf; nfhz;bUf;FkhW Xa;tpy; ,Uf;fpwJ. jiu kw;Wk; mhypd; cuha;Tf; nfof;fs; KiwNa \( \mu \) and \( \mu' \) vdpy; jfL efuj; Jtq;Fk; epiyapy; fpil jsj;jld; mg;gf;fk; mifk;Fk; Nfhzk; \( \tan^{-1}(1 - \mu' / 1 + 2\mu + \mu') \) vd epWTf.

20 (a) Find the C.G of a hollow Hemisphere.

(m) cs;sPlw;w miuf;Nfhzj;jpy; Gtp <Hg;G ikak; fhz;f.

(or)

(b) Obtain the equation of the parabolic catenary.

(M) gutisa rq;fpyplj;jpd; rkd;ghl;ilf; fhz;f.
Real Analysis - I

Time: Three hours

Maximum Marks: 100 marks

Answer all questions

SECTION A (10 x 1 = 10 marks)

1. If $a/bc$ and $(a,b) = 1$, then ---------------
   $a/bc \neq (a,b) = 1, \sqrt{aQTM} ---------------$

2. For every real $x$, there is a positive integer $n$ such that ---------------
   $\exists \delta \in \mathbb{Q} \quad x, \exists \quad \sqrt{a} \in \mathbb{I} \implies \exists \quad \frac{1}{4} \in \mathbb{Q}$.

3. If $A$ and $B$ are countable sets, then $A \cup B$ is ---------------
   $A, B \not\subseteq \mathbb{N} \implies A \cup B \sqrt{aQTM} AUB \sqrt{aQTM}$

4. The set of all irrational numbers is ---------------
   $\mathbb{R} \setminus \mathbb{Q}$

5. If $x, y \in \mathbb{R}^n$, then $\|x - y\| \leq \|x\| + \|y\|$
   $x, y \in \mathbb{R}^n, \sqrt{aQTM} \|x - y\| \leq \sqrt{aQTM} \|x\| + \|y\|$

6. The set $\left\{ \frac{1}{n}, n = 1, 2, 3, \ldots \right\}$ has --------------- as an accumulation point
   $\left\{ \frac{1}{n}, n = 1, 2, 3, \ldots \right\}$

7. Which of the following is compact
   $H \not\subseteq \mathbb{Q} \implies \not\subseteq \mathbb{N}$

8. Find the boundary of a set of all rational numbers in $\mathbb{R}'$ is ---------------
   $\mathbb{R}' \setminus \mathbb{Q}$

9. Find the limit of the sequence $\left\{ \frac{1}{2^1}, \frac{1}{2^2}, \frac{1}{2^3}, \ldots \right\}$
   $\left\{ \frac{1}{2^1}, \frac{1}{2^2}, \frac{1}{2^3}, \ldots \right\}$

10. If $f(x) = 2x$, $g(x) = \cos x$, then $g \cdot f(x) = -------------
    f(x) = 2x \implies g \cdot f(x) = \sqrt{aQTM} \cdot f(x) = -------------

SECTION B (5 x 6 = 30 marks)

11. (a) State and prove Lindelöf of covering theorem.
    $\mathbb{L} \not\subseteq \mathbb{Q} \implies \not\subseteq \mathbb{N}$

    (or)

(c) State and prove unique factorization theorem.
    $\mathbb{A} \not\subseteq \mathbb{Q} \implies \not\subseteq \mathbb{N}$
12. (a) Prove that every subset of a countable set is countable.

(b) If \( F \) is a collection of sets, then show that for any set \( B \),
\[
A = \bigcap_{\alpha \in F} (B - A)
\]

13. (a) Prove that the intersection of a finite collection of open sets is open.

(b) Prove that \( \|x + y\| \leq \|x\| + \|y\| \)

14. (a) Prove that \( e \) is irrational.

(b) If \((s,d)\) is a metric subspace of \((m,d)\), \( Y \) is a subset of \( S \). Show that \( Y \) is closed in \( s \) if and only if \( \bar{Y} = B \) for some set \( B \) which is closed in \( M \).

15. (a) If \( \{x_n\} \) converges in a metric space \((s,d)\), prove that for any \( \varepsilon > 0 \), there is an integer \( N \) such that \( d(x_n, x_m) < \varepsilon \) for \( n, m \geq N \).

(b) If in a metric space \((s,d)\), \( x_n \to p \) and \( T = \{x_1, x_2\} \) is the range of \( \{x_n\} \) then show that
   (i) \( T \) is bounded
   (ii) \( P \) is an adherent point of \( T \).

16. (a) If \( a \) and \( b \) are any two integers with greatest common divisor \( d \), prove that there exist two integers \( x \) and \( y \) such that \( d = ax + by \).

SECTION C (5 x 12 = 60 marks)
(b) If \( x \geq 0 \) prove that every integer \( r \geq 1 \), there is a finite decimal \( r_n = a_0, a_1, a_2, \ldots, a_n \) such
\[
x \leq r_n \leq r_n + \frac{1}{10^n}
\]
\[
x \geq 0 \quad \Rightarrow \quad r_n \leq x \leq r_n + \frac{1}{10^n}
\]
\[
\Rightarrow \quad r_n = a_0, a_1, a_2, \ldots, a_n \quad \Rightarrow \quad \text{every } \frac{1}{10^n} \text{ is } \text{GÅ¾è}.
\]

17. (a) Show that the set of all real numbers is uncountable.
\[
\text{â‰Œ â‡€O} \Rightarrow \text{â‡€Ei} \Rightarrow \text{â€œ} \Rightarrow \text{â‘”} \Rightarrow \text{Àù â€œ}.
\]
(or)
(b) Let \( f: S \rightarrow T \) be a function. If \( A \) and \( B \) are arbitrary subsets of \( S \). Prove that
\[
\begin{align*}
(i) f(A \cup B) &= f(A) \cup f(B) \\
(ii) f(A \cap B) &\leq f(A) \cap f(B)
\end{align*}
\]
\[
\Rightarrow \quad f: S \rightarrow T \Rightarrow \text{â†€} \Rightarrow \text{â¯ÈL} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]

18. (a) State and prove Bolzano Weierstrass theorem.
\[
\text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]
(or)
(b) State and prove Cantor’s intersection theorem.
\[
\text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]

19. (a) State and prove Heine – Borel theorem.
\[
\text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]
(or)
(b) If \( S \) is a subset of a metric space \( M \). Prove that the following statements are equivalent:
\[
\begin{align*}
(i) &\quad S \text{ is Compact.} \\
(ii) &\quad S \text{ is closed and bounded.} \\
(iii) &\quad \text{Every infinite subset of } S \text{ has an accumulation point in } S.
\end{align*}
\]
\[
\Rightarrow \quad \text{âŠ™ â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]
\[
(i) S \Rightarrow \text{â†€} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]

20. (a) In the Euclidean space \( \mathbb{R}^k \), Prove that every Cauchy sequence is convergent.
\[
\Rightarrow \quad \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]
(or)
(b) If \( f \) and \( g \) are continuous at \( p \) then prove that \( h = g \circ f \) is also continuous at \( P \).
\[
\Rightarrow \quad \text{âŠ™ â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{â€œ} \Rightarrow \text{ÂPGÅ¾è}.
\]
COMPLEX ANALYSIS - I

Time: Three hours      Maximum Marks: 100 marks

Answer all questions

SECTION A (10 x 1 = 10 marks)

1. If \( Z_1, Z_2 \) are two complex numbers, then \( |Z_1 + Z_2| \)

2. If \( \omega \) is the cube root of unity then \( 1 + \omega + \omega^2 = \) 

3. If \( f(Z) \) is continuous at \( Z_0 \), then \( \lim_{Z \to Z_0} f(Z) = \)

4. If \( f(Z) \) is differential at \( Z_0 \), then \( \lim_{Z \to Z_0} \frac{f(Z) - f(Z_0)}{Z - Z_0} = \)

5. For the geometric \( \Re + Z^2 + \ldots \) is

6. \( \frac{e^z + e^{-z}}{z} = \)

7. If \( u = x^2 + y^2 \) is a harmonic function then \( V = \)

8. If \( u \) is harmonic then \( U_x^2 + U_y^2 = \)

9. If \( C: |Z| = 2 \) then find \( \int_C \frac{dz}{z - 1} = \)

10. If \( C: |Z| = 1 \) then find \( \int_C \frac{e^z}{z} dz = \)

SECTION B (5 x 6 = 30 marks)

11. (a) If \( Z_1, Z_2 \) are any complex numbers, then prove that (i) \( |Z_1 + Z_2| = |Z_1| + |Z_2| \) (ii) \( |Z_1, Z_2|^2 = |Z_1|^2 + |Z_2|^2 + 2 \text{Re}(Z_1 \overline{Z_2}) \)
12. (a) Obtain the equation of a circle on the join of A(Z₁) and B(Z₂) as diameter.
A(Z₁), B(Z₂) āiø 1ōOè¬÷ Ƥ¬¬, 9 «èξ†¬¬ì M†iïëè ⁷ëξ†i ô†iFì êñiœ Ė′
è£‡ê.
(b) Obtain the C-R equations.
C-R ūëξèÔ ê¬÷ Ë¼M,ê.

13. (a) State and prove Abel's theorem of uniform convergence of a power series.
Üî´° ⁴îëÍK™ Yó£è â½fš ãð™v «îÝo¬¬ì ŬP GÁ ¾ëè.
(b) Prove that e\(^z\) is not defined at Z= ∞
Z= ∞ āiø '1ōOJ™ e\(^z\) ð¬¬ôôÅ,è ⁷ëôëÔ ūë GÁ¾ëè.

14. (a) Show that \(u = x^3 - 3xy^2 + x\) is a harmonic function. Find the corresponding
analytic function.
\[u = x^3 - 3xy^2 + x\] ¹¾ ê¬¬ êëâë¬¬ì ūë GÁ¾ëè. Ūì ūëè¬¬ì Ôë¬¬ì êëëëè.
(b) Discuss the transformation \(w = e^z\).
\[w = e^z\] āiø â¼ïëÝô¬¬ì ñMōK.

15. (a) State and prove Cauchy's integral formula.
«èëCJ\(\) ⁷ëξ¬¬ì ôëëëΣôë†¬¬ì, ŬP GÁ¾ëè.
(b) Evaluate \(\oint_C \frac{dz}{z^2 - 1}\) along C the positively oriented circle|z|=1.
C âiðì|z|=1 āiø I¬¬ô õ†ì ôëFJ™ ⁷ëôëÔ ⁰ôë†¬¬ì ôëôëì ñFš\(\) ⁰ôëÔ ūë GÁ¾ëè.

SECTION C (5 x 12 = 60 marks)

16. (a) Explain Stereographic projection.
û©K«ôëAôëH, iô™ MôK.
(b) Prove that \(|Z₁ - Z₂| ≥ |Z₁| + |Z₂|\)
\(|Z₁ - Z₂| ≥ |Z₁| + |Z₂|\) ūë GÁ¾ëè.

17. (a) State and Prove C-R equation in polar Co-ordinates.
«ëëôë¬¬Ýô° C-R ⁷ëξ¬¬ôJ™ êñiðëÔ†¬¬ì ŬP GÁ¾ëè.
(b) Show that (i) \(\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2\) (ii) \(\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)\log|f'(z)| = 0\)
18. (a) (i) State and Prove the uniqueness theorem for representation of a function by a power series.

(ii) Prove that \( e^{\zeta_1} \cdot e^{\zeta_2} = e^{\zeta_1 + \zeta_2} \)

(b) Discuss the logarithmic function.

19. (a) If \( f(Z) \) is analytic in a region \( D \) and if \( f'(Z) \neq 0 \) in \( D \) then prove that the mapping \( w = f(Z) \) is conformal in \( D \).

(b) Discuss the transformation \( w = \frac{1}{2}(z + \frac{1}{2}) \).

20. (a) State and Prove the Cauchy’s theorem using Goursat lemma.

(b) State and Prove the Morera’s theorem .

MODERN ALGEBRA -I

SECTION – A

1. \( G \) is a group and \( a, b \in G \). The solution of \( ya = b \) is ____________.

2. If \( a^*b = a^2 + b^2 \), then find \( 2*3 \).

3. Number of generators of a cyclic group of order \( n \) is ______________.

4. If \( H \) is a subgroup of \( G \) and \( O(G) = 21 \) then find \( O(H) \).

Time : 3 Hours       Maximum : 100 Marks

SECTION – A      ( 10 X 1 = 10 )
5. If $G$ is a group and $f(x)=e$ for all $x \in G$ then $\ker f=?$. 
$G \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u}$

6. The index of $A_n$ in $S_n$ is ________.

7. If $\cdot$ is the multiplication mod 7 then $\overline{5} \cdot \overline{4} = ________.$

8. If the non-zero elements of a ring $R$ form a group under multiplication then $R$ is called ________.

9. Find the zero element of the ring $RIU$.

10. $[a_1, b] + [c, d] = ? [a_1, b] + [c, d] = ?.$

SECTION – B

11. (a) Let $\sigma : S \rightarrow T$ and $\tau : T \rightarrow U$. Prove that $\sigma \circ \tau$ is 1-1 if each of $\sigma$ and $\tau$ is 1-1. Is the converse true? Justify.

12. (a) Prove that a subgroup of a cyclic group is cyclic.

13. (a) Prove that a homomorphism $\phi$ of $G$ into $\overline{G}$ with kernel $K_\phi$ is an isomorphism if and only if $K_\phi = \{e\}$.

(OR)

(b) If $G$ is an infinite cyclic group. Prove that $A(G) \cong \text{Cyclic group of order} 2$.

G $\overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u} \overset{\phi}{\rightarrow} \mathbb{A}\mathbb{u}$
14.  (a) Prove that every finite integral domain is a field.
\[ \mathbb{Z}/\mathbb{Z} \] is a field.

(OR)

(b) Let \( R \) be a ring. Let \( a, b, c, d \in R \). Evaluate \((a+b)(c+d)\) and \((a+b)^2\).
\[ R \] and \[ a, b, c, d \in R \] are given.

\[ (a+b)(c+d) = ac + ad + bc + bd \]
\[ (a+b)^2 = (a+b)(a+b) = a^2 + ab + ba + b^2 \]

15.  (a) Show that the ideal \( U = (n_o) \) in the ring of integers is maximal \( \iff \) \( n_o \) is a prime number.
\[ \mathbb{Z}/\mathbb{Z} \]

(OR)

(b) If \( U \) is an ideal of \( R \) prove that the ring \( R/U \) is a homomorphic image of \( R \).
\[ R \]

\[ U \] is given.

16.  (a) If \( \sigma : S \to T \), \( \tau : T \to U \) and \( \mu : U \to Y \) Prove that

(i) \( (\sigma \circ \tau) \circ \mu = \sigma \circ (\tau \circ \mu) \)

(ii) \( (\sigma \circ \tau) \) is one to one if each of \( \sigma \) and \( \tau \) is one to one.

(iii) \( (\sigma \circ \tau) \) is onto if each of \( \sigma \) and \( \tau \) is onto.

\[ \sigma : S \to T \], \( \tau : T \to U \), \( \mu : U \to Y \] are given.

(OR)

(b) In a group \( G \) the equations \( a \cdot x = b \) and \( y \cdot a = b \) have unique solutions for \( x \) and \( y \) in \( G \). Prove this.
\[ G \]

(i) \( l \cdot a \cdot b = c \cdot d \) for three consecutive integers I show that \( G \) is abelian.

(ii) \( l \cdot a \cdot b = c \cdot d \) \iff \( G \) is abelian.

17.  (a) (i) If \( O(G) = P \), a prime number, prove that \( G \) is a cyclic group.

(ii) Show that the intersection of two normal subgroups of \( G \) is a normal subgroup of \( G \).
\[ G \]

(i) \( O(G) = P \) for a prime number \( P \) \iff \( G \) is a cyclic group.

(ii) \( G \) and \( H \) are given.

(OR)

(b) Let \( H \) and \( K \) be two subgroup of a group \( G \). Define \( HK \). Give an example to show that \( HK \) need not be a subgroup of \( G \). Prove that \( HK \) is a subgroup if and only if \( HK = KH \).
\[ H, K \] are given.

\[ H \cdot K = \{ h \cdot k \mid h \in H, k \in K \} \]

(OR)

\[ H \cdot K \] is defined.

\[ H \cdot K \] is given.
18. (a) State and Prove the fundamental theorem of homomorphism of groups.

\[ \text{HK} = \{ \delta \mathbb{A}_1 \} \]

(OR)

(b) Prove that any non abelian group of order 6 is isomorphic to \( S_3 \).  
\[ \{1, \pi, \tau\} \]

19. (a) (i) Show that \( \sqrt{2} \in \mathbb{Q} \) is a commutative ring with identity under usual addition and multiplication of real number. Here \( J \) is the set of integers.

(ii) If \( f \) is a field, Prove its only ideals are \((0)\) and \( F \) itself.

(OR)

(b) Write a short note on real quaternions.

20. (a) Prove that an ideal \( M \) of a commutative ring \( R \) with unit element is maximal \( \iff \) \( R/M \) is a field.

(OR)

(b) Prove that every integral domain can be imbedded in field.

Real Analysis - II

Time: Three hours
Maximum Marks: 100 marks

Answer all questions

SECTION A (10 x 1 = 10 marks)

1. A metric space \( S \) is connected if every two valued function on \( S \) is

2. Every open interval in \( R \) is

3. \( (0,1) \cup (2,3) \) is

4. Uniform continuity on a set \( A \) implies

\[ A \cap \{ y \in \mathbb{R} : y \leq a \} \]

\[ A \cap \{ y \in \mathbb{R} : y > a \} \]
5. If \( f \) is differentiable at \( C \), then \( f \) is \( \lim_{x \to C} \) at \( C \).

6. If \( f(x) = (x-a)(b-x) \); \( a \leq x \leq b \), then find the value of \( C \) in Rolle's theorem is \( \frac{a+b}{2} \).

7. If \( V_{f(a,b)} = 0 \), then \( f \) is \( \lim_{x \to C} \) on \([a,b] \).

8. The set of polynomial functions with integer coefficients is \( \mathbb{Z}[x] \).

9. If \( P' \) is finer than \( P \), then \( \lim_{x \to C} \) \( \mathbb{R} \)

10. In Riemann–Stieltjes integral, a remarkable connection exists between the integrand and the \( \int_{a}^{b} \).

SECTION B (5 x 6 = 30 marks)

11. (a) Let \( f: S \to T \) be a function from \((s,ds)\) to \((T,dt)\). If \( f \) is continuous on a compact subset \( X \) of \( S \),
    Prove that \( f(x) \) is a compact subset of \( T \).

12. (a) If every two valued function \( S \) is constant then a metric space \( S \) is connected.

13. (a) State and prove Rolle's theorem.

14. (a) If \( f \) and \( g \) are bounded variation on \([a,b] \), show that \( V_{f,g} \leq AV_{f} + BV_{g} \)
    where \( A = \sup_{x \in [a,b]} |g(x)| \), \( B = \sup_{x \in [a,b]} |f(x)| \).
    (b) If \( f \) is monotonic on \([a,b] \), prove that the set of discontinuities of \( f \) is countable.
15. (a) Prove that:
\[ \int_{a}^{b} f(C_1 \alpha + C_1 \beta) = \int_{a}^{b} f \alpha + \int_{a}^{b} f \beta \]

SECTION C (5 x 12 = 60 marks)

16. (a) If \( f: S \rightarrow T \) be a function from \( (s, ds) \) to \( (T, dt) \). Show that \( f \) is continuous on \( S \) if and only if

\[ f \text{ or every open set } Y \text{ in } T, f^{-1}(Y) \text{ is open in } S. \]

(b) If \( f: S \rightarrow M, \) if \( X \) be a connected subset of \( S \) and if \( f \) is continuous on \( X \), then \( f(X) \) is a connected subset of \( M \).

17. (a) Prove that every open connected set in \( \mathbb{R}^n \) is arcwise connected.

(b) Let \( f \) takes only positive values in \( (a, b) \), then \( f \) is strictly increasing on \( [a, b] \).

18. (a) If \( f \) and \( g \) are continuous on \( [a, b] \) and have and equal finite derivatives in \( [a, b] \) then \( f-g \) is constant on \( [a, b] \).

(b) State and prove intermediate value theorem for derivatives.

19. (a) Let \( f \) be of bounded variation on \( [a, b] \). If \( x \in [a, b] \), let \( V(x) = V_f(a, x) \) and \( V(a) = 0 \). Then prove that every point of continuity of \( f \) is also a point of continuity of \( V \). Also prove that the converse is also true.
(b) Let $f$ be of bounded variation on $[a,b]$. If $c \in [a,b]$, then prove that $f$ is bounded variation on $[a,c]$ and on $[c,b]$ and $V_f(a,b) = V_f(a,c) + V_f(c,b)$.

20. (a) If $f \in R(\alpha)$ on $[a,b]$, show that $\alpha \in R(f)$ on $[a,b]$ and

$$\int_a^b f(x)dx + \int_a^b \alpha(x)dx = f(b)\alpha(b) - f(a)\alpha(a)$$

(b) Assume $f \in R(\alpha)$ on $[a,b]$ and $\alpha$ has continuous derivative $\alpha'$ on $[a,b]$. Show that

$$\int_a^b f(x)\alpha'(x)dx$$

exists and

$$\int_a^b f(x)d\alpha = \int_a^b f(x)\alpha'(x)dx$$

The above can be used as a basis for further investigations.
COMPLEX ANALYSIS - II

Time: Three hours       Maximum Marks: 100 marks

Answer all questions

SECTION A (10 x1 =10 marks)

1. Find the value of the integral \[ \int_C \frac{dz}{z(z^2-3z+3)} \] where \( C \) is the circle \( |z| = 3 \)

2. If \( f(z) \) is analytic inside and SCR curve \( C \), then the maximum value occurs at-------

3. The region of validity for the function \( \log(1-z) \) is ------------------

4. Find the value of \[ \int_C \frac{dz}{(z^2+2z+2)} \] where \( C \) is the circle \( |z| = 1 \)

5. Find Singular points of \( f(z) = \frac{1}{z(z-1)} \).

6. The residue of \( \frac{(5z-2)}{(z^2-z)} \) at \( z=1 \) is ------

7. An analytic function in the extended plane is ----------

8. By using residue theorem. Find \[ \int_C \frac{dz}{(z^2+2z+2)} \]

9. A function which is meromorphic in the extended plane is ----------

10. Write the value of \( \Delta_c \arg f(z) \)

\[ \Delta_c \arg f(z) \]
SECTION B (5 x 6 = 30 marks)

11. (a) State and prove Liouville’s theorem.
\[ \text{L«ó£M™hv} \text{ «îŸøˆ¬î ĄP GÁ¾è.} \]

(or)

(b) State and prove the fundamental theorem of Algebra.
\[ \text{ÞòŸèEî¨F} \text{ «îŸøˆ¬î ĄP GÁ¾è.} \]

12. (a) State and prove uniqueness theorem on Taylor’s series.
\[ \text{ªìŒô˜ ªî£ìK¡ 弬ñˆ ñ «îŸøˆ¬î ĄP GÁ¾è .} \]

(or)

(b) If \( C \) is the positively oriented circle \( |z - i| = 2 \), show that \( I = \int_{C} \frac{1}{(t^2 + 4)^2} \, dt = \frac{\pi}{16} \).
\[ \text{C â¡ð¶ å¼ º¿¬ñò£ù õ†ì‹} \]

13. (a) Find the residue of \( f(z) = \frac{z^2}{(z-1)^2(z+2)} \) at each of the poles.
\[ \text{f(z) =} \frac{z^2}{(z-1)^2(z+2)} \text{ åj®â˜ · â€†H} \]

(b) Define removable singularity. Give an example.
\[ \text{c,êŠð†ì CœŠ¹ 'œO¬ò õ¬óòÁˆ¶ â´ˆ¶'裆´ì¡ M÷' ° è.} \]

14. (a) Show that \( \int_{0}^{2\pi} \frac{d\theta}{a+b \sin \theta} = \frac{2\pi}{\sqrt{a^2-b^2}}, a > |b| \)
\[ \int_{0}^{2\pi} \frac{d\theta}{a+b \sin \theta} = \frac{2\pi}{\sqrt{a^2-b^2}}, a > |b| \text{ âù GÁ¾è.} \]

(or)

(b) Evaluate \( \int_{0}^{\infty} \frac{dx}{(x^2-1)^2} \)
\[ \text{ñFŠH´è.} \text{I} \int_{0}^{\infty} \frac{dx}{(x^2-1)^2} \]

15 (a) State and prove the fundamental theorem of algebra by using Rouche’s theorem.
\[ «ó£„ê˜v «îŸøˆ¬î ðò¡ð´ˆF ÞòŸèEî¨Físt «îŸøˆ¬î ĄP GÁ¾è.} \]

(or)

(b) Use Rouche’s theorem to show that the equation \( z^2 + 15z + 1 = 0 \) has one root in the disc \( |z| < \frac{3}{2} \) and four roots in the annulus \( \frac{3}{2} < |z| < 2 \)
\[ «ó£„ê˜v «îŸøˆ¬î ðò¡ð´ˆF \text{ z}^2 + 15z + 1 = 0 \text{ åjø êøò®í®́j åj®́ Íd· ç|z|<} \]

16. (a) State and prove Cauchy’s theorem.
(\text{or})
(b) State and prove Maximum modulus theorem.
17. (a) State and prove Taylor’s series.
(\text{or})
(b) Expand \( f(z) = \frac{1}{(z-1)(z-2)} \) in Laurents series if (i) \( |z| < 1 \) (ii) \( |z| > 2 \) (iii) \( 1 < |z| < 2 \)
18. (a) State and prove Cauchy’s Residue theorem.
(\text{or})
(b) (i) Define removable singularity and essential singularity.
(ii) Find the residue \( f(z) = \frac{\sin z}{z \cos z} \)
(iii) \( M \ddot{S} \ddot{d} \ddot{t} i Q^{\ddot{i}} \ddot{r} - \ddot{n} \ddot{n} \ddot{Y} \ddot{A} \ddot{c} \ddot{i} - \ddot{o} \ddot{L} \ddot{u} \ddot{i} Q^{\ddot{i}} \ddot{r} - \ddot{n} \ddot{e} - \ddot{r} \ddot{o} - \ddot{d} \ddot{d} \ddot{A} \ddot{c} \) \( \ddot{i} - \ddot{o} \ddot{d} \ddot{L} \ddot{u} \ddot{i} Q^{\ddot{i}} \ddot{r} - \ddot{n} \ddot{e} - \ddot{r} \ddot{o} - \ddot{d} \ddot{d} \ddot{A} \ddot{c} \) \( \ddot{H} \ddot{i} \ddot{a} \ddot{\ddot{r}} - \ddot{i} \ddot{,} \ddot{e} \ddot{e} \ddot{.} \ddot{e} \ddot{.} \)
19. (a) Prove that \( \int_{0}^{\infty} \frac{x^2}{x^2 + 4} \left( \frac{x^2}{x^2 + 9} \right) \frac{dx}{x} = \frac{\pi}{200} \)
\( \int_{0}^{\infty} \frac{x^2}{(x^2 + 4)^2} \left( \frac{x^2}{x^2 + 9} \right) \frac{dx}{x} = \frac{\pi}{200} \) \( \ddot{a} \ddot{u} \ddot{G} \ddot{A} \ddot{g} \ddot{d} \ddot{.} \ddot{e} \ddot{.} \)
(\text{or})
(b) Evaluate \( \int_{0}^{\infty} \frac{\sin x}{x} \) \( \ddot{a} \ddot{e} \ddot{i} \ddot{A} \ddot{\ddot{g}} \ddot{e} \)
20. (a) Prove that a function which is memorable in the extended plane is a rational function.

(b) If \(a > e\), use Roucher's theorem to prove that equation \(e^z = az^n\) has \(n\) roots inside the circle \(|z| = 1\).

Modern Algebra - II

Time: Three hours

Maximum Marks: 100 marks

Answer all questions

SECTION A (10 x 1 = 10 marks)

1. If

\[
\begin{bmatrix}
1 & 3 & 4 \\
2 & 4 & 6 \\
1 & -1 & 0
\end{bmatrix}
\]

\(+ B = \begin{bmatrix}
2 & 2 & 0 \\
1 & -2 & 1 \\
3 & 4 & 2
\end{bmatrix}\)

then find \(B\).

2. Find all diagonal elements of a hermitian matrix

\[
\begin{bmatrix}
\cos \alpha & \sin \alpha \\
-\sin \alpha & \cos \alpha
\end{bmatrix}
\]

3. Find the inverse of

\[
\begin{bmatrix}
-1 & 0 & 2 \\
1 & 1 & -1 \\
0 & 0 & -1
\end{bmatrix}
\]

4. If \(S\) and \(T\) are subsets of a vector space \(V\), \(L(SUT) - L(S)\) is

--------------------------
5. If \( \dim A \)- \( \dim B = 10 \), then \( \dim (A \cap B) \) is \( \boxed{\dim A - \dim B = 10} \). Then \( \dim (A + B) = \boxed{\dim A + \dim B - \dim (A \cap B)} \).

7. The value of \((\alpha u, \beta u)\) is \boxed{\( (\alpha u, \beta u) \cdot 1 \)}.

8. \( \bigcup_{1}^{7} (\alpha_1 \cup_1 + \alpha_2 \cup_2 + \ldots + \alpha_n \cup_n) \) is \boxed{\( \bigcup_{1}^{7} (\alpha_1 \cup_1 + \alpha_2 \cup_2 + \ldots + \alpha_n \cup_n) \)}.

9. If \( UT = \lambda U \) then \( UT^4 \) is \boxed{\( UT^4 \)}.

10. A linear transformation is an element of \boxed{\( \mathbb{R}^n \)}.

SECTION B (5 x 6 = 30 marks)

11. (a) Find \( (A + 2B)^2 \) where

\[
A = \begin{bmatrix}
1 & -2 & 3 \\
2 & 3 & -1 \\
-4 & 9 & 5
\end{bmatrix}, \quad B = \begin{bmatrix}
1 & 2 & -1 \\
-2 & -1 & 2 \\
1 & -3 & -1
\end{bmatrix}
\]

\( \Rightarrow \boxed{\begin{bmatrix}
\text{?} & \text{?} & \text{?} \\
\text{?} & \text{?} & \text{?} \\
\text{?} & \text{?} & \text{?}
\end{bmatrix}} \).

(or)

(b) Define a symmetric matrix. Give an example of a matrix which is symmetric matrices \( A \) and \( B \) that \( AB \) is not symmetric.

\( \Rightarrow \boxed{\text{Example}} \).

12. (a) Define a unitary matrix. Show that the matrix \( \frac{1}{5} \begin{bmatrix}
-1+2i & -4-2i \\
2-4i & -2-i
\end{bmatrix} \) is unitary.

\( \Rightarrow \boxed{\text{Example}} \).

(b) Verify Cayley Hamilton theorem for \( A = \begin{bmatrix}
1 & 0 & 2 \\
0 & 2 & 1 \\
2 & 0 & 3
\end{bmatrix} \) and hence find \( A^n \).

\( \Rightarrow \boxed{\text{Example}} \).
13. (a) Show that the vectors (1,0,-1), (2,1,3), (-1,0,0) and (1,0,1) are linearly dependent in $\mathbb{R}^3$.

(b) If $U_1, U_2, U_3, \ldots, U_n$ are in $V$, then prove either they are linearly independent or some $U_k$ linear combination of the preceding ones $U_1, U_2, U_3, \ldots, U_k$.

14. (a) Prove that $L(s)$ is a subspace of $V$.

(b) State and prove the Schwarz inequality.

15. (a) If $V$ is finite dimensional over $F$, prove that $T \in A(V)$ is invertible if and only if the constant term of the minimal polynomial for $T$ is not zero.

(b) Prove that $T \in A(V)$ is completely determined by its values on a basis of $V$.

16. (a) (i) For any square matrix $A$ of order $n$, prove that $A(adj A) = (adj A) - (det A) I_n$.

(ii) If $A$ and $B$ are symmetric, show that $AB-BA$ is skew symmetric.

(b) Express $A = \begin{bmatrix} 2 + 3i & 1 - i & 2 + i \\ 3 & 4 + 3i & 5 \\ 1 & 1 + i & 2i \end{bmatrix}$ as a sum of a hamitian and skew hermitian matrix.

(ii) Prove that $A = \begin{bmatrix} -1 & 2 & 3 \\ 2 & -1 & 2 \\ 2 & 2 & -1 \end{bmatrix}$ is orthogonal.
A = \begin{bmatrix}
-1 & 2 & 3 \\
2 & -1 & 2 \\
2 & 2 & -1 \\
\end{bmatrix} \ \overset{3}{=}
\begin{bmatrix}
-1 & 2 & 3 \\
2 & -1 & 2 \\
2 & 2 & -1 \\
\end{bmatrix}
\begin{flushright}
\text{â¡ø ÜE ÚÈ àù GÁ¾è.}
\end{flushright}

17. (a) (i) Find the rank of
\begin{bmatrix}
1 & -1 & 0 & 2 & 1 \\
3 & 1 & 1 & -12 & \\
4 & 0 & 1 & 0 & 3 \\
9 & -1 & 2 & 3 & 7 \\
\end{bmatrix}
\begin{flushright}
\begin{bmatrix}
1 & -1 & 0 & 2 & 1 \\
3 & 1 & 1 & -12 & \\
4 & 0 & 1 & 0 & 3 \\
9 & -1 & 2 & 3 & 7 \\
\end{bmatrix}
\end{flushright}
\begin{flushright}
\text{â¡ø ÜE¬ô îó°¬î, ª£‡è.}
\end{flushright}

(ii) Find the characteristic roots of the matrix
\begin{bmatrix}
1 & -1 & 2 \\
-2 & 1 & 3 \\
3 & 2 & -3 \\
\end{bmatrix}
\begin{flushright}
\begin{bmatrix}
1 & -1 & 2 \\
-2 & 1 & 3 \\
3 & 2 & -3 \\
\end{bmatrix}
\end{flushright}
\begin{flushright}
\text{â¡ø ÜEJ¡ CoŠHò™¹ Íôƒè¬÷ èț¬'H®.}
\end{flushright}

(or)

(b) Compute the transpose, adjoint and inverse of the matrix.
\begin{bmatrix}
1 & -1 & 0 \\
0 & 1 & -1 \\
1 & 0 & 1 \\
\end{bmatrix}
\begin{flushright}
\begin{bmatrix}
1 & -1 & 0 \\
0 & 1 & -1 \\
1 & 0 & 1 \\
\end{bmatrix}
\end{flushright}
\begin{flushright}
\text{â¡ø ÜEJ¡ ŋ£ŸÁ ÜE, P¬í ÜE, «țníΣÁ ÜE P¬ôè¬÷, èț¬'H®.}
\end{flushright}

18. (a) If \( V \) is finite dimensional over \( F \), prove any two bases of \( V \) have the same number of elements.
\begin{flushright}
F ¡ e¶ v á¼ 9ô®ÅÁ ðKñžì 9ôO âQ™ TM â‰î P¼ Ü®, êífeÀ: êë ãfÈ,¬æ á¬–¬î áÅŠ¹ê¬÷, 9ê£®9¼,9 ãù GÁ¾è.
\end{flushright}

(b) If \( V \) is finite dimensional and if \( W \) is a subspace of \( V \), prove that \( W \) is finite dimensional.
\( \dim W \leq \dim V + \dim \frac{V}{W} \).
\begin{flushright}
V á¼ 9ô®ÅÁ ðKñžì 9ôO ŋÝÁ: w ájåí vJj ãø®9ôO âQ™ w á¼ 9ô®ÅÁ ðKñžì®¬îôå jA::
\end{flushright}
\( \dim W \leq \dim V \) âjÅ: ŋÝÁ: \( \dim V = \dim W + \dim \frac{V}{W} \) ãù GÁ¾è

19. (a) If \( V \) and \( W \) are of dimension \( m \) and \( n \), respectively over \( F \), prove that \( \text{Hom}(V,W) \) is dimension \( mn \) over \( F \).
\begin{flushright}
F ¡ e¶ ðKñžì m ,n è¬÷ à¬–¬î 9ô,i 9ôOèce V, W âQ™ F ¡ e¶ Hom(V,W)¡ ðKñžì àù GÁ¾è.
\end{flushright}
(or)

(b) Let \( V \) be the set of all polynomials of degree \( \leq 2 \). \( V \) is a real inner product space with the inner product defined by \( \langle f, g \rangle = \int_{-1}^{1} f(t)g(t)dt \). Starting with the basis \( \{1, x, x^2\} \) obtain the orthogonal basis for \( V \).

\[ V \] is a real inner product space with the inner product defined by
\[ \langle f, g \rangle = \int_{-1}^{1} f(t)g(t)dt \]

Starting with the basis \( \{1, x, x^2\} \) obtain the orthogonal basis for \( V \).

\[ \langle f, g \rangle = \int_{-1}^{1} f(t)g(t)dt \]

Starting with the basis \( \{1, x, x^2\} \) obtain the orthogonal basis for \( V \).

20. (a) If \( V \) is a finite dimensional inner product space and if \( w \) is a subset of \( V \), prove that
(i) \( V = W + W \)
(ii) \( w \cap w^\perp = 0 \) (ii) \( (w^\perp)^\perp = w \)
(iii) \( \langle f, g \rangle = \int_{-1}^{1} f(t)g(t)dt \)

(b) Let \( V \) be the vector space of polynomials of degree 3 or less over \( \mathbb{F} \). In \( V \) define \( T \) by
\[ (\alpha_0 + \alpha_1 x + \alpha_2 x^2 + \alpha_3 x^3)T = \alpha_i + 2\alpha_i x + 3\alpha_i x^2 \]
compute the matrix of \( T \) in the basis.

(i) \( 1, x, x^2, x^3 \)
(ii) \( 1, 1 + x, 1 + x^2, 1 + x^3 \)
(iii) if the matrix in part (i) is \( A \) and that in part (ii) is \( B \), find a matrix such that \( B = cA^{-1} \).
AOS – Numerical Methods I

Time: 3 Hours

Section A (10 x 1 = 10 Marks)

Answer all Questions

(1) The equation \( x^3 - 4x - 9 = 0 \) will have a real root between 

(2) The order of convergence of Newton-Raphson method is .................

(3) Gauss elimination method is a .................. method.

(4) The rate of convergence of Gauss – Seidal method is roughly ................. that of Jwabi method.

(5) \( \Delta^2 \) is called the ..................... order difference operator.

(6) The central difference \( \delta y_x = ................. \)

(7) State Gauss’s forward interpolation formula

(8) State Stirling’s formula

(9) If \( f(x) = \frac{1}{x} \) find the divided difference \( f(a,b) \) and \( f(a,b,c) \).

(10) Write the Lagrange’s interpolation formula for unequal intervals.

Section B (5 x 6 = 30 Marks)

(11) (a) Obtain a root of \( x^3 - x - 1 = 0 \) using bi section method.

(b) Describe the method of false position.
(12) (a) Solve by Gauss elimination method.

\[ \begin{align*}
3x - y + 2z &= 12 \\
x + 2y + 3z &= 11 \\
2x - 2y - z &= 2 \\
\end{align*} \]

(b) Using Gauss – Jordan method, solve.

\[ \begin{align*}
2x - 3y + z &= -1 \\
x + 4y + 5z &= 25 \\
3x - 4y + z &= 2 \\
\end{align*} \]

(13) (a) Show that

\[ y_3 = y_2 + \Delta y_1 + \Delta^2 y_0 + \Delta^3 y_0 \]

\[ y_3 = y_2 + \Delta y_1 + \Delta^2 y_0 + \Delta^3 y_0 \]

(b) Obtain the function whose first difference is \( 9x^2 + 11x + 5 \)

(14) (a) using the following table, apply Gauss’s forward formula to get \( f(3.75) \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>24.145</td>
<td>22.043</td>
<td>20.225</td>
<td>18.644</td>
<td>17.262</td>
<td>16.047</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>( x )</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>24.145</td>
<td>22.043</td>
<td>20.225</td>
<td>18.644</td>
<td>17.262</td>
<td>16.047</td>
</tr>
</tbody>
</table>
(b) If \( \sqrt{12500} = 111.803399, \sqrt{12510} = 111.848111, \sqrt{12520} = 111.892805, \)
\( \sqrt{12530} = 111.937483 \), find \( \sqrt{12516} \) by Gauss’s backward formula.

True

(15) (a) From the following table find \( f(x) \) and here \( f(6) \) using Newton’s interpreter formula.

\[
\begin{array}{c|c}
 x & 1 & 2 & 7 & 8 \\
 f(x) & 1 & 5 & 5 & 4 \\
\end{array}
\]

(or)

(b) Using Lagrange’s formula of interpretation find \( y (9.5) \) given

\[
\begin{array}{c|c|c|c}
 x & 7 & 8 & 9 & 10 \\
 y & 3 & 1 & 1 & 9 \\
\end{array}
\]

Section – C (5 x 12 = 60 Marks)

(16) (a) Find the positive root of \( x^2 = 2 \) by the method of false position.

True

(or)

(b) Find the real root of the equation \( x^3 - 6x + 4 = 0 \) between 0 and 1 using Newton – Raphson method.

True

(17) (a) Solve by Gauss – Seidal method.

True
(18) (a) Express any value \( f \) Y in terms of \( Y_n \) and the backward differences of \( Y_n \).

(b) Find the second difference of \( Y \) with \( h = 2 \).

(19) (a) Find the value of \( \cos 510 \, 421 \) by using Gauss’s backward interpolation formula from the table given below.

<table>
<thead>
<tr>
<th>( X )</th>
<th>500</th>
<th>510</th>
<th>520</th>
<th>530</th>
<th>540</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y = \cos x )</td>
<td>.6428</td>
<td>.6293</td>
<td>.6157</td>
<td>.6018</td>
<td>.5878</td>
</tr>
</tbody>
</table>

(b) From the following table using Stirling’s formula estimate the value of \( \tan 16 \)
(20) (a) Using Newton's divided difference formula, find the values of \( f(2) \), \( f(8) \) and \( f(15) \) given the following table.

<table>
<thead>
<tr>
<th>( X )</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F(x) )</td>
<td>4.8</td>
<td>100</td>
<td>294</td>
<td>900</td>
<td>2028</td>
</tr>
</tbody>
</table>

(b) Find the value of \( \theta \) given \( f(\theta) = .3887 \) where \( f(\theta) = \int_0^\theta \frac{d\theta}{\sqrt{1 - \frac{1}{2} \sin^2 \theta}} \) using the table

<table>
<thead>
<tr>
<th>( \theta )</th>
<th>21(^\circ)</th>
<th>23(^\circ)</th>
<th>25(^\circ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(\theta) )</td>
<td>.3706</td>
<td>.4068</td>
<td>.4433</td>
</tr>
</tbody>
</table>

**DISCRETE MATHEMATICS**

Time : 3 Hours      Maximum : 100 Marks

SECTION – A       ( 10 X 1 = 10 )

1. A _________ is an expression which is a string consisting of variables, parentheses and connective symbols.

2. The dual of \( (P \land Q) \lor T \) is _________

3. \( P \rightarrow Q \iff \ldots \)

4. If \( f(x) = x + 2 \) and \( g(x) = x^2 - 1 \) then find \( (g \circ f)(x) \)

5. If \( s \rightarrow \alpha s \) and \( s \rightarrow \alpha \) be the productions in a grammar \( G \), then the grammar is called _________.

6. _________ is one in which rows are represented by states and columns are represented by input symbols.

7. \( (\alpha, *, \oplus) \) be a lattice and \( a, b \in L \), then \( a \ast (a \oplus b) = a \) is called _______.
8. If a and b be any two elements of a Boolean algebra then \( a * (a' \oplus b) = \) ______

9. A graph that has neither self loops nor parallel edges is called a ___________

10. If the degree of the vertex are equal then it is called _____________

SECTION – B       ( 5 X 6 = 30 )

11. (a) Prove that \( P \rightarrow (Q \rightarrow R) \Leftrightarrow (P \land Q) \rightarrow R \).

(b) Obtain the principle conjunctive normal form of

\[ P \lor (7P \rightarrow (Q \lor (7Q \rightarrow R))) \]

12. (a) Show that \( (7P \land (7Q \land R)) \lor (Q \land R) \lor (P \land R) \Leftrightarrow R \)

(b) Define Composite function. Also let \( f : R \rightarrow R \) and \( g : R \rightarrow R \) defined by

\( f(x) = 4x - 1 \), \( g(x) = \cos x \) then find \( fog \) and \( gof \).

13. (a) Define

(i) Deterministic Finite Automaton.

(ii) Non Deterministic Finite Automaton.

(b) Explain the procedure for converting the given non-deterministic finite automata and finite automata.

14 (a) State and Prove the distributive in equality of a lattice.

(b) In any Boolean Algebra, Prove that \( (a \land b)' = a' \lor b' \) and \( (a \lor b)' = a' \land b' \)

15 (a) Define the following terms with example.

(i) Connected Graph

(ii) Hamiltonian Cycle

(b) “Every tree can be uniquely represented by a binary tree” discuss with example.

SECTION – C       ( 5 X 12 = 60 )

16 (a) Show that

(i) \( 7 (P \land Q) \rightarrow (7P \lor (7P \lor Q)) \Leftrightarrow (7P \lor Q) \)

(ii) \((P \lor Q) \land (7P \land (7P \lor Q)) \Leftrightarrow (7P \land Q)\)

(b) Show that the following are equivalent formulae

(i) \( P \lor (P \land Q) \Leftrightarrow P \)

(ii) \( P \lor (7P \land Q) \Leftrightarrow P \lor Q \)

17 (a) Show that
(x) ( P(x) ∨ Q(x) ) ⇒ (x) P(x) ∨ ( ∃ x ) Q(x)

(b) (i) What is equivalence relation? Give an example.

(ii) Let R be a binary relation on the set of all positive integers such that
R = { (a,b) | a = b^2 }. Is R Reflexive? Symmetric? Anti Symmetric?

18 (a) Define the following grammar.
(i) Context Sensitive Grammar
(ii) Context Free Grammar
(iii) Regular Grammar

(OR)
(b) Explain deterministic finite automaton. Also give a DFA accepting the set of all strings over {0,1} with three consecutive 0's.

19 (a) Let ( <, ≤ ) be a lattice. For any a, b, c ∈ L. Prove that the following distributive inequations hold
\[ a ⊕ ( b * c ) ≤ (a ⊕ b) * ( a ⊕ c ) \]
\[ a * ( b ⊕ c ) ≥ (a * b) ⊕ ( a * c ) \]

(OR)
(b) Find the canonical form of a Boolean function.

\[ F = [ x + (x' + y') ] * [ x + (y' * z') ] \]

20 (a) Define the following with an example.
(i) Multi Graph
(ii) Euler Graph
(iii) Isomorphic Graph

(OR)
(b) Explain the matrix representation of graphs with example.
Section - B  

(5x6=30)

11 a. Prove that the number of vertices of odd degree in a graph is even 
(OR) 
b. If G is a connected graph with exactly 2k odd vertices, prove that there exist k edge-disjoint subgraphs such that they together contain all edges of G and that each is a univursal graph.

12. a. Prove that a tree with n vertices has \((n-1)\) edges. 
(OR) 
b. Prove that a graph with n vertices \((n-1)\) edges and no circuits is connected.

13. a. Define the vertex connectivity and edge connectivity of a graph. Prove that the vertex connectivity of a graph can never exceed its edge connectivity. 
(OR) 
b. Prove that the complete graph on five vertices is non planar.

14 a. If B is a circuit matrix of a connected graph G with e edges and n vertices, prove that rank of B = e-n+1 
(OR) 
b. Define path matrix and illustrate with an example

15. a. Prove that every tree with two or more vertices is 2 – chromatic 
(OR) 
b. Prove that a graph on a vertices is complete if and only if its chromatic polynomial is 
\[ p_n(\lambda) = \lambda(\lambda-1)(\lambda-2)\ldots(\lambda-n+1) \]

Section - C  

(5x12=60)

16. a. Prove that a simple graph on n vertices and k components can have almost \((n-k)\) \((n-k+1)/2\) edges. 
(OR) 
b. Prove that a connected graph is an Euler graph if and only if all vertices are of even degree.

17. a. Define the center of a graph. Prove that every tree has either one vertex or two adjacent vertices as its center. 
(OR) 
b. Prove that a spinning tree T of a given weighted connected graph is a shortest spanning tree of G if and only if there exists no other spinning tree of G if and only if there exists no other spanning tree of G at a distance of one from T whose weight is smaller than that of T.

18. a. Prove that the maximum vertex connectivity that can achieve with a graph on n vertices and e edges \((e \geq n-1)\) is \((2e/n)\)
b. State and prove the Euler's Formula for a connected planar graph.

19. a. Prove that the rank of \( A(G) \) is \( n-1 \) where \( A(G) \) is the incidence matrix of a connected graph \( G \).

(OR)

b. If \( A \) and \( B \) are respectively, the circuit matrix and the incidence matrix whose columns are arranged using the same order of edges, prove that \( A.B^T = B.A^T = 0 \) (mod 2)

20 a. Explain what is a chromatic number and chromatic polynomial of a graph. Find the chromatic polynomial for the graph \( G \) given below.

![Graph G](image)

(OR)

b. Prove that the vertices of every planar graph can be properly colored with five colors.

**********

AOS – Numerical Methods II

Time : 3 Hours  
Maximum : 100 Marks

Section – A (10 x 1 = 10 Marks)  
Answer all Questions

1. The relation between \( E \) and \( \Delta \) is ............
   \( E \kw; Wk; \Delta d; bjhlh; g \[/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/][/.returnValue
6. $\delta$ is given in terms of $E$ as ...............

\[ \delta = \text{vd;gJ E-ia bgWj;J} \]

$\delta$

7. Write down the Milne’s predictor and Corrector algorithm.

8. Write decon Reange – Kutta algorithm (4\textsuperscript{th} order)

\[ u';nf ? Fl;lh Kiwia vGJf/ \]

9. Euler’s method is a Taylor’s series method of .......... order.

\[ Ma;yh; Kiw vd;gJ ila;yh; bjhlhp; \]

10. State the Adams – Bashforth Predictor corrected formula.

Section – B (5 x 6 = 30 Marks)

(11) (a) Find the first derivative of the function tabulated below at $x = 0.6$

<table>
<thead>
<tr>
<th>$x$</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>1.5836</td>
<td>1.7974</td>
<td>2.0442</td>
<td>2.3275</td>
<td>2.6511</td>
</tr>
</tbody>
</table>

gpd;tUk; ml;ltizapy; ,Ue;J $x = 0/6$ vd;w g[s;spapy; Kjy; tiff; bG fhz;f/ 

(OR)

(b) Given the following data, find the maximum value of $y$

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>0</td>
<td>.25</td>
<td>0</td>
<td>2.25</td>
<td>16.00</td>
<td>56.25</td>
</tr>
</tbody>
</table>

gpd;Uk; tpgu';fspypUe;J y kPg;bgU kjpg;ig fhz;f/ 

(12) a) Using the following data, find $f'(5)$.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>4</td>
<td>26</td>
<td>58</td>
<td>112</td>
<td>466</td>
<td>922</td>
</tr>
</tbody>
</table>

gpd;Uk; tpgu';fspypUe;J $f'(5)$ I fhz;f/ 

(OR)
(12) (b) Evaluate $\int_{0}^{1} \frac{1}{1+x^2} \, dx$ using Trapezoidal rule with $h = 0.25$;

$$h = 0.25$$

(13) (a) Find the difference equation from $y_{x+1} = a.2^x + b.3^x$

$$y_{x+1} = a.2^x + b.3^x$$

(OR)

(b) Find the difference equation from $y_{x+1} = a.2^x + b(-2)^x$

$$y_{x+1} = a.2^x + b(-2)^x$$

(14) (a) Using Taylor’s series method find $y(0.1)$ given $\frac{dy}{dx} = x+y$, $y(0) = 1$.

$$\frac{dy}{dx} = x+y, \quad y(0) = 1$$

(OR)

(b) Given $y' = -y$ and $y(0) = 1$ determine the values of $y$ at $x = 0.01, 0.02$ by Euler method.

$$y' = -y, \quad y(0) = 1$$

(15) (a) Using Milne’s method find $y(4.4)$ given $5xy' + y^2 - 2 = 0$ given $y(4) = 1,$ $y(4.1) = 1.0049$ $y(4.2) = 1.0097$ and $y(4.3) = 1.0143$.

$$y(4.1) = 1.0049, \quad y(4.2) = 1.0097, \quad y(4.3) = 1.0143$$

(OR)

(b) Solve and get $y(2)$ given $\frac{dy}{dx} = \frac{1}{2}(x+y), \quad y(0) = 2$ $y(0.3) = 2.636$ $y(1) = 3.595$ $y(1.5) = 4.968$ by Adam’s method.

$$\frac{dy}{dx} = \frac{1}{2}(x+y), \quad y(0) = 2, \quad y(0.3) = 2.636, y(1) = 3.595, y(1.5) = 4.968$$

(16) (a) Use Newton-Gregory forward formula find the value of $Y$ when $x = 142^0$. 

Section – C (5 x 12 = 60 Marks)
(17) (a) Evaluate \( \int_0^1 e^x \, dx \) by Simpson's Me third rule correct to five decimal places, by proper choice of h.

(b) Evaluate \( \int_{-3}^3 x^4 \, dx \) by using (1) Trapezoidal rule (2) Simpson's rule verify your results by actual integration.

(18) (a) solve \( y_{x+2} - y_{x+1} + y_x = 0 \) given \( y_0 = 1, y_1 = \frac{\sqrt{3}+1}{2} \)

(b) Solve \( \Delta u_x + \Delta^2 u_x = \cos x \)

(19) (a) Compute \( y \) at \( x = 0.25 \) by modified Euler method given \( y' = 2xy, y(0) = 1 \)

(b) Apply the fourth order Runge Kutta method to fixed \( y(0.2) \) given that \( y' = x + y, y(0) = 1 \)
(20) (a) Determine the value of \( y(0.4) \) using Mline’s method given \( y' = xy + y^2 \), \( y(0) = 1 \) use Taylor series to get the values of \( y(0.1) \), \( y(0.2) \) and \( y(0.3) \).

\[
y' = xy + y^2, \quad y(0) = 1 \quad \text{(vdpy)}; \quad y(0.1), \quad y(0.2) \quad \text{kw;Wk}; \quad y(0.3)d; \quad \text{kjpg;g[fi}s bla;yhp; Nj;jpui;ij gad;gL;j;p bgw;W y(0.4) d; kjpg;ig Kiwia gad;gL;j;p fhz;f/}
\]

(OR)

(b) Find \( y(0.1) \), \( y(0.2) \), \( y(0.3) \) from \( \frac{dy}{dx} = xy + y^2 \), \( y(0) = 1 \) by using Runge-kutta method and hence obtain \( y(0.4) \) using Adam’s method.

\[
\frac{dy}{dx} = xy + y^2, \quad y(0) = 1 \quad \text{(OR)}
\]

---

**OPERATIONS RESEARCH - I**

Time: 3 Hours  
Maximum: 100 Marks

**SECTION – A**  
(10 X 1 = 10)

1. Give any two definitions or OR.  
2. Write down the phases of OR.  
3. Define Feasible solution.  
4. Define Slash Variable.  
5. What is meant by dual problem?  
6. The dual of dual is ______.  
7. Define : Non – degenerate basic feasible solution in transportation model.  
8. What is optimum utilization of the transportation model?  
9. Compare Transportation and Assignment models.  
10. Write down the mathematical representation of assignment models.

**SECTION – B**  
(5 X 6 = 30)

11. (a) Briefly explain scientific methods in operations research.  
    OR - y «EcAcAs ÖÈ,Ç AeÇîl.,

(OR)

11. (b) Discuss the significance and scope of OR in modern management.
12 (a) Show that these is an unbounded solution to the following L.P.P.
Maximize \( Z = 4x_1 + x_2 + 3x_3 + 5x_4 \)
Subject to
\[
\begin{align*}
4x_1 - 6x_2 - 5x_3 - 4x_4 & \geq -20 \\
-3x_1 + 2x_2 + 4x_3 + x_4 & \leq 10 \\
-8x_1 - 3x_2 + 3x_3 + 2x_4 & \leq 20 \\
x_1, x_2, x_3, x_4 & \geq 0
\end{align*}
\]
(OR)
(b) What are the steps involved in charnes penalty method?

13 (a) Write the dual of the following L.P.P.
(i) Maximize \( Z = 5x_1 + 8x_2 \)
Subject to
\[
\begin{align*}
3x_1 + 5x_2 &= 18 \\
5x_1 + 3x_2 &= 14 \\
\end{align*}
\]
x_1, x_2 \geq 0
(ii) Maximize \( Z = 5x_1 + 8x_2 \)
Subject to
\[
\begin{align*}
x_1 - 2x_2 & \leq 1 \\
x_1 + 2x_2 & \geq 3
\end{align*}
\]
x_1, x_2 \geq 0
(OR)
(b) Write the dual of the following L.P.P.
(i) Minimize \( Z = x_1 + 2x_2 + x_3 \)
Subject to
\[
\begin{align*}
x_1 + & \frac{1}{2} x_2 + \frac{1}{2} x_3 \leq 1 \\
\frac{3}{2} x_1 + 2x_2 + x_3 & \geq 8 \\
x_1, x_2, x_3 & \geq 0
\end{align*}
\]
(ii) Minimize \( Z = 2x_1 + 3x_2 \)
Subject to
\[
x_1 - 2x_2 \leq 0
\]
\[
-2x_1 + 3x_2 \geq -6 \\
\text{x}_1, x_2 \text{ Unrestricted}
\]

ÁçýÅÔò L.P.P. -ý pO’Á’Äj,íň.

(i) \[Á€i\%êÉeÁ¾ílít Z = x_1 + 2x_2 + x_3\]
\[x_1 + \frac{1}{2} x_2 + \frac{1}{2} x_3 \leq 1\]
\[\frac{3}{2} x_1 + 2x_2 + x_3 \geq 8 \quad x_1, x_2, x_3 \geq 0\]

(ii) \[Á€i\%êÉeÁ¾ílít Z = 2x_1 + 3x_2\]
\[x_1 - 2x_2 \leq 0\]
\[-2x_1 + 3x_2 \geq -6 \quad x_1, x_2 \text{ Unrestricted}\]

14 (a) Explain the Voge’s Approximation method.
§Å¡ì¸¢ý §¾¡Ã¡Â ӨȨ ŢÅâ.

(OR)

(b) What are the steps involved in formulation of transportation?
§Å¡ì¸¢ý ØÉ A Á£ô¦ÀÕõ Å¢üÀ¨É¡Ç÷¸¨Ç ¿¡ýÌ Á¡Åð¼ò¾¢üÌ Å¢üÀ¨É¢ø ¿¡ýÌ Á¡Åð¼ò¾¢üÌ Á£ô¦ÀÕõ Å¢üÀ¨É¢ø ¿¡ýÌ Á£ô¦ÀÕõ Å¢üÀ¨É¢ø.

15 (a) A company has a team of four salesman and these are four districts where the company wants to starts its business. After talking into account the capabilities of salesmen and the nature of districtly the company estimates that the profit per day in rupees for each salesman in each district is as below.

<table>
<thead>
<tr>
<th>District</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>16</td>
<td>10</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>B</td>
<td>14</td>
<td>11</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>D</td>
<td>13</td>
<td>12</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

\[\text{Á£ô¦ÀÕõ \% 4} \quad \text{Á£ô¦ÀÕõ \%} \quad 4\]

(OR)

(b) Solve the following Assignment Problem.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>17</td>
<td>8</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>7</td>
<td>12</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>16</td>
<td>15</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>24</td>
<td>17</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>10</td>
<td>12</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>V</td>
</tr>
<tr>
<td>---</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>17</td>
<td>8</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>7</td>
<td>12</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>16</td>
<td>15</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>24</td>
<td>17</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>10</td>
<td>12</td>
<td>11</td>
<td>15</td>
</tr>
</tbody>
</table>

**SECTION – C** \( (5 \times 12 = 60) \)

16. (a) Discuss the role of OR models in decision making.

(b) Find the maximum as well as minimum value of the objective function \( Z = 4x + 5y \)
Subject to \( 2x + y \leq 6 \)
\( x + 2y \leq 5 \)
\( x - 2y \leq 2 \)
\( -x + y \leq 2 \)
\( x + y \geq 1 \)
\( x, y \geq 0 \)

(OR)

17. (a) Use M-technique to solve the following L.P.P.
Minimize \( Z = 4x_1 + x_2 \)
Subject to \( 3x_1 + x_2 = 3 \)
\( 4x_1 + 3x_2 \geq 6 \)
\( x_1 + 2x_2 \leq 3 \)
\( x_1, x_2 \geq 0 \)

(OR)

(b) Use two phase method to solve
Maximize \( Z = 5x - 2y + 3z \)
Subject to
2x + 2y – z ≥ 2
3x – 4y ≤ 3
y + 3z ≤ 5  \quad x, y, z ≥ 0

\[ \text{Maximize } Z = 5x - 2y + 3z \]

\[ 2x + 2y - z ≥ 2 \]
\[ 3x - 4y ≤ 3 \]
\[ y + 3z ≤ 5 \quad x, y, z ≥ 0 \]

18 (a) Use duality to solve the following L.P.P.
Maximize \( Z = 3x_1 + 2x_2 \)
Subject to
\[
\begin{align*}
x_1 + x_2 & \geq 1 \\
x_1 + x_2 & \leq 7 \\
x_1 + 2x_2 & \leq 10 \\
x_2 & \leq 3 \\
x_1, x_2 & \geq 0
\end{align*}
\]

(OR)

(b) Use Duality to solve the following L.P.P.
Minimize \( Z = 3x_1 + 2x_2 + 5x_3 \)
Subject to
\[
\begin{align*}
x_1 + x_2 + x_3 & \leq 9 \\
2x_1 + 3x_2 + 5x_3 & \leq 30 \\
2x_1 - x_2 - x_3 & \leq 8 \\
x_1, x_2, x_3 & \geq 0
\end{align*}
\]
\[ \begin{align*}
\delta \delta A_{11} + & \leq 9 \\
2x_1 + & \leq 30 \\
2x_1 - & \leq 8 \quad x_1, x_2, x_3 \geq 0
\end{align*} \]

19 (a) Give a mathematical formulation of the transportation and simplex methods. What are the differences in the nature of problems that can be solved by these methods.

(OR)

(b) Solve the following transportation problem.

\[
\begin{array}{ccc|cccc}
\text{Stores (Destination)} & & & & & \\
1 & 9 & 12 & 9 & 6 & 9 & 10 & 5 \\
2 & 7 & 3 & 7 & 5 & 5 & 6 \\
3 & 6 & 5 & 9 & 11 & 3 & 11 & 2 \\
4 & 6 & 8 & 11 & 2 & 2 & 10 & 9 \\
\hline
\text{Requirement} & 4 & 4 & 6 & 2 & 4 & 2 \\
\end{array}
\]

20 (a) Explain the Hungarian Assignment Algorithm.

(OR)

(b) Solve the following Assignment Problem.

\[
\begin{array}{|c|cccccc|}
\hline
\text{A} & 12 & 10 & 15 & 22 & 18 & 8 \\
\text{B} & 10 & 18 & 25 & 15 & 16 & 12 \\
\text{C} & 11 & 10 & 3 & 8 & 5 & 9 \\
\text{D} & 6 & 14 & 10 & 13 & 13 & 12 \\
\text{E} & 8 & 12 & 11 & 7 & 13 & 10 \\
\hline
\end{array}
\]
OPERATIONS RESEARCH - II

Time : 3 Hours
Maximum : 100 Marks

SECTION – A
(10 X 1 = 10)

1. What are the rules for graph theory?
   
2. Define: optimal strategies.
   


5. Define: Demand.


7. What is simulation?

8. What is monte – carlo method ?


10. Define: Successor activities.

SECTION – B
(5 X 6 = 30)

11 (a) Explain Two person zero sum game.

(b) Write down the properties of competitive Games.

12 (a) Explain the classification of Queueing system.

(b) Explain the elements of Queueing system.

13 (a) Explain the various costs associated with inventory control.

(b) Explain the E.O.Q. with price break.

14 (a) A tourist cab owner has 25 taxis in operation. He keeps three derives as reserve to attend to calls in case the scheduled driver reports sick the probability distribution of sick driver is as below.

<table>
<thead>
<tr>
<th>Number sick</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.20</td>
</tr>
<tr>
<td>1</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>0.20</td>
</tr>
<tr>
<td>3</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>0.12</td>
</tr>
<tr>
<td>5</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Use Manot carlo method to estimate the utilization of reserve derives and the probability that of least method will be off the road due to non-availability of a driver. Compare with the correct answer.

(OR)

(b) Find the value of $\Pi$ experimentally by simulation.

15 (a) Write down the rules of Network Construction.

(OR)

(b) Construct the network diagram comprising activities B,C, ..... Q and N such that the following constraints are satisfied.

$B < E, F; \quad C < G, L; \quad E, G < H; \quad L, H < I; \quad L < M; \quad H < N; \quad H < J; \quad I, J < P; \quad P < Q$

The relation $X < Y$ means that the activity $X$ must be finished before $Y$ can begin.

 SECTION – C

(5 X 12 = 60)

16 (a) Reduce the following game by dominance and find the game value.

$$\begin{array}{cc|cccc}
\text{Player – A} & I & II & III & IV \\
\hline
\text{I} & 3 & 2 & 4 & 0 \\
\text{II} & 3 & 4 & 2 & 4 \\
\text{III} & 4 & 2 & 4 & 0 \\
\text{IV} & 0 & 4 & 0 & 8 \\
\end{array}$$

$$\begin{array}{cc|cccc}
\text{Player – B} & -5 & 5 & 0 & -1 & 8 \\
\end{array}$$

(OR)

(b) Solve the following game by graphic method.

$$\begin{array}{cc|cccc}
\text{Player – A} & I & II & III & IV \\
\hline
\text{I} & 3 & 2 & 4 & 0 \\
\text{II} & 3 & 4 & 2 & 4 \\
\text{III} & 4 & 2 & 4 & 0 \\
\text{IV} & 0 & 4 & 0 & 8 \\
\end{array}$$

$$\begin{array}{cc|cccc}
\text{Player – B} & -5 & 5 & 0 & -1 & 8 \\
\end{array}$$
17 (a) Explain the characteristics of Queueing Models.

(OR)

(b) A super market has two girls running up sales at the counters. If the service time for each customer is exponential with mean 6 minutes and if people arrive in a Poisson fashion at the rate of 12 per hour,

(i) What is the probability of having to wait for service?
(ii) What is the expected number of customers in the queue?

18 (a) Derive the EOQ formula for shortage model.

(OR)

(b) The annual demand for a product 1,00,000 units. The rate of production is 2,00,000 units per year. The set up cost per production run is Rs.5,000 and the production cost of each item is Rs.10. The annual holding cost per unit is 20% of the value of the unit. Find the optimum production lot-size and the length of the production run.

19 (a) Three points are chosen at random on the circumference of a circle. Find by Monto – carlo methods the probability that they lie on the same semi-circle.

(OR)

(b) A company has a single service station which has the following characteristics the mean arrival rate of customer and the mean service time 6.2 minutes and 5.5 minutes respectively. The time between and arrival and its service varies from one minute to seven minutes. He arrived service time distribution are given below.

<table>
<thead>
<tr>
<th>Time (Minutes)</th>
<th>Arrival (Probability)</th>
<th>Service (Probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>2-3</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>3-4</td>
<td>0.35</td>
<td>0.40</td>
</tr>
<tr>
<td>4-5</td>
<td>0.25</td>
<td>0.20</td>
</tr>
<tr>
<td>5-6</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>6-7</td>
<td>0.05</td>
<td>-</td>
</tr>
</tbody>
</table>

The queueing process starts at 11 A.M. and closes at 12 P.M. An arrival moves immediately into the service facility if it is empty. On the other hand if the service station is busy, the arrival will wait in the queue. Customers are served on the first come, first served basis.
If the clerk’s wages are Rs.6 per hour, would the customer’s waiting line costs, Rs.5 per hour, would it be economical for the manager to engage the second clerk? Use Monte – carlo simulation technique.

20 (a) Calculate the variance and expected activity times for the activities of the network shown in the figure below under calculation in the tabular form.

\[
\begin{array}{c|c|c|c|c|c|c|c}
\text{Activity} & \text{1-2} & \text{1-3} & \text{1-4} & \text{2-5} & \text{3-5} & \text{4-6} & \text{5-6} \\
\text{to} & 1 & 1 & 1 & 2 & 2 & 2 & 3 \\
\text{tm} & 1 & 4 & 2 & 1 & 5 & 5 & 6 \\
\text{tp} & 7 & 7 & 8 & 1 & 14 & 8 & 15 \\
\end{array}
\]

(i) Draw the project network and identify all the paths throughout
(ii) What is the expected project length?
(iii) Calculate the variance D.S.D. of project length
(iv) If the project due date is 18 weeks, what is the probability of not meet the due date?
OPERATIONS RESEARCH - III

Time : 3 Hours      Maximum : 100 Marks

SECTION – A       ( 10 X 1 = 10 )

1. What is L.P.P.?

2. What is Gamorian constraints?

3. Write down a General N.L.P.P.

4. Write down Keeton – Tucter conditions.

5. What is Dynamic Programming Problem?

6. Write down the principle of optimality in Dynamic Programming Problem.

7. Define Stochastic Process

8. What is mean by transition probability?

9. Write the basic steps involved in the Laplace criterion.

10. What is EMV.

SECTION – B       ( 5 X 6 = 30 )

11. (a) Explain All Integer Cutting Plane Algorithm.

(b) Explain Mixed Integer Cutting Plane Algorithm.

12. (a) Obtain the set of necessary condition for the non-linear programming problem.

Subject to

(b) Solve the following L.P.P.

Minimize Z = 2x₁² - 24x₁ + 2x₂² - 8x₂ + 2x₃² - 12x₃ + 200

Subject to x₁ + x₂ + x₃ = 11

x₁, x₂, x₃ ≥ 0
13 (a) Briefly explain the characteristic of Dynamic Programming.

(b) Use Dynamic Programming to find the value of

\[ Z = 2x_1^2 - 24x_1 + 2x_2^2 - 8x_2 + 2x_3^2 - 12x_3 + 200 \]
\[ x_1 + x_2 + x_3 = 11 \]
\[ x_1, x_2, x_3 \geq 0 \]

(OR)

14 (a) What are the steps involved in construction of a state-transition matrix.

(b) Test whether the Markov chain having the following transition matrix in regular and cryodic. When \( x \) represents some positive \( P_{ij} \) value.

\[
\begin{array}{cccc}
1 & 2 & 3 & 4 \\
1 & 0 & x & x & 0 \\
2 & x & 0 & 0 & x \\
3 & x & 0 & 0 & x \\
4 & 0 & x & x & 0 \\
\end{array}
\]

\( P_{ij} \) is defined as the probability of going from state \( i \) to state \( j \).

\( \sum_{j=1}^{n} P_{ij} = 1 \)

15 (a) A decision problem has been expressed in the following pay off table.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Out Come</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>A</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>30</td>
</tr>
<tr>
<td>C</td>
<td>40</td>
</tr>
</tbody>
</table>

(i) What is the minimum pay off action?

(ii) What is the minimum opportunity loss function?
(OR)

(b) Explain EOL.
EOL $\Rightarrow$.

SECTION – C  $(5 \times 12 = 60)$

16 (a) Find the optimum integer solution to the all integer programming problem.
Maximize $Z = x_1 + x_2$
Subject to

$$3x_1 + 2x_2 \leq 1$$
$$x_2 \leq 5$$
$x_1, x_2 \geq 0$ and all integer

(OR)

(b) Find the optimum integer solution to the following all I.P.P.
Maximize $Z = x_1 + 2x_2$
Subject to

$$x_1 + x_2 \leq 7$$
$$2x_1 \leq 11$$
$$2x_2 \leq 7$$
$x_1, x_2 \geq 0$ and all integers

(OR)

17 (a) Obtain the necessary and sufficient conditions for the optimum solution of
the following L.P.P.
Minimize $Z = f(x_1, x_2) = 3e^{2x_1} + 2e^{x_1+5}$

Subject to the constraints

$x_1 + x_2 = 7$ and $x_1, x_2 \geq 0$

(OR)

(b) Solve the following L.P.P.
Optimize $Z = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$
Subject to the constraints
\[ \begin{align*} 
    x_1 + x_2 + x_3 &= 15 \\
    2x_1 - x_2 + 2x_3 &= 20 \\
    x_1, x_2, x_3 &\geq 0 
\end{align*} \]

18 (a) Use Dynamic Programming to show that
\[ Z = P_1 \log P_1 + P_2 \log P_2 + \ldots + P_n \log P_n \]
Subject to the constraints
\[ P_1 + P_2 + P_3 + \ldots + P_n = 1 \text{ and } P_j \geq 0 \quad (j = 1, 2, 3 \ldots n) \]
is minimum where \( P_1 = P_2 = P_3 = \ldots = P_n = \frac{1}{n} \)

(OR)

(b) Divide a positive quantity \( C \) into ‘n’ parts in such a way that their products is a maximum.

‘c’ ±ûØ ô Dr. «Ç’ Ä |‡îôi, ã Íîy Œ ± Ô ±cæ, i, ‘n’ pôôi, ’iÜÉ Ä Ê¾÷ ãóæ, j, ÅcÅc.

19 (a) Define statimay distribution. Obtain the limiting distribution of the three – state markov chain with transition probability matrix.

\[
\begin{bmatrix}
0.5 & 0.3 & 0.2 \\
0.2 & 0.4 & 0.4 \\
0.1 & 0.5 & 0.4
\end{bmatrix}
\]

(OR)

(b) Obtain \( P^n \) for the following transition probability matrix

\[
\begin{bmatrix}
1-a & a \\
b & 1-b
\end{bmatrix}, \quad 0 < a, \quad b < 1
\]

\[
\begin{bmatrix}
1-a & a \\
b & 1-b
\end{bmatrix}, \quad 0 < a, \quad b < 1
\]

20 (a) The Estimated sales of proposed types of perfumes are as under

<table>
<thead>
<tr>
<th>Types of Perfumes</th>
<th>Estimated level of sales (Units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs.20,000</td>
<td>Rs.10,000</td>
</tr>
</tbody>
</table>
(i) For each of the following decisions, state the optimal action and specify the value leading to its section: (a) Maximin (b) Maximax (c) Laplace (d) Minimax regret

(ii) What will be the optimal act if the payoff entries represent the costs instead of sales?

(OR)

(b) Consider the following payoff matrix.

<table>
<thead>
<tr>
<th></th>
<th>$\theta_1$</th>
<th>$\theta_2$</th>
<th>$\theta_3$</th>
<th>$\theta_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_1$</td>
<td>5</td>
<td>10</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>$a_2$</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>$a_3$</td>
<td>21</td>
<td>18</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>$a_4$</td>
<td>30</td>
<td>22</td>
<td>19</td>
<td>15</td>
</tr>
</tbody>
</table>

Solve this using Hurlicj Criterion with $\alpha = 0.75$. 

(OR)