GULBARGA UNIVERSITY

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ನಂ.: ಕ್ರಮ/ಸಂದರ್ಭ/ನಿಯಮಾಂಶ/2018-19 / 5718

ಮರಾಠಿ

ಮರಾಠಿ: ತಾಂತ್ರಿಕ ಪರಂಪರೆಯು ಮತ್ತು ಸಾಗರವಿನ ರೋಗ ಮಾರ್ಗವಿನಲ್ಲಿ ಸಮಾರಂಭವನ್ನು ಅನುಭವಿಸಿದರೆಯೇ ಆಗಿರುತ್ತಾಯಾಗಿರುತ್ತಾ ಮತ್ತು ಹೊರಕೆಯ ಮೇಲೆ.

ನುಡಗಾಡಿ: 1) ಕರ್ನಾಟಕ ಅರೈನಾಟಿಕಾಂಗಾ ನೆಚ್ಚು ಧಾರ್ಮಿಕ 11.06.2018.
2) ಸಂಸ್ಥಾನ: ವಿಶ್ವವಿದ್ಯಾಲಯ ಧಾರ್ಮಿಕ 14.06.2018.
3) ಜೀವಾಂಕಿಕಾ ಸಂಬಂಧಿಸಿ ಕಲ್ಲು ಸಂಶೋಧನೆ 11ರಂದು 26.06.2018.

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ಮರಾಠಿ: (3) ತಾಂತ್ರಿಕ ಪರಂಪರೆಯು ರೋಗಗ್ರಾಹಿಗಳನ್ನು ಕಲ್ಲು ಸಂಶೋಧನೆ 11ರಂದು ಸಂಬಂಧಿಸಿಕೊಂಡು ವಿಶ್ವವಿದ್ಯಾಲಯ: ತಾಂತ್ರಿಕ ಪರಂಪರೆಯು ಕ್ರಮಗಳನ್ನು ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯ ಮೇಲೆ.


ದಿನಾಂಕ: ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯ ಮೇಲೆ ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯ ಮೇಲೆ.

ನೆನ್ನಿಸಿರುವುದು, ಸ್ಥಾನಕರ್ತರ ಪ್ರಭಾವ ಕುಲಗಳು ಸಂಪರ್ಕಾಂಶಗಳು ವಿಶ್ವವಿದ್ಯಾಲಯ ಹೊರಕೆಗಳು www.gug.ac.in ವಿಸ್ತಾರದ ಮೇಲೆ.

ಕೀ:
1. ಸಂಪನ್ನೆಯ, ತಾಂತ್ರಿಕ ಪರಂಪರೆಯು ವಿದ್ಯಾರ್ಥಿ, ಸಂಬಂಧಿಸಿಕೊಂಡು.
2. ಹಾಗೇ ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು ಮೇಲೆ.

ವಿಷಯ:
1. ತಾಂತ್ರಿಕ, ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು ವಿದ್ಯಾರ್ಥಿ, ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು.
2. ಸಂಬಂಧಿಸಿಕೊಂಡು (ಯುದ್ಧಸಾಧನಾನ್ನು), ಸಾಂಪ್ರದಾಯಿಕ ಮೇಲೆ ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು.
3. ಕಲ್ಲು ಸಂಶೋಧನೆ, ಮೇಲೆ ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು ವಿಶ್ವವಿದ್ಯಾಲಯ ಆಧ್ಯತ್ಮ ನುಡಗಾಡಿ.
4. ಸಂಬಂಧಿಸಿಕೊಂಡು, ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು.
5. ಮತ್ತು ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು.
6. ಮತ್ತು ಸಂಬಂಧಿಸಿಕೊಂಡು, ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು.
7. ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು / ಸಂಬಂಧಿಸಿಕೊಂಡು ಸಂಬಂಧಿಸಿಕೊಂಡು ಹೊರಕೆಯು.
GULBARGA UNIVERSITY, KALABURAGI
DEPARTMENT OF MATHEMATICS

PROPOSED SYLLabus OF

MATHEMATICS

FOR SIX SEMESTER B. Sc. DEGREE COURSE

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

WITH EFFECT FROM 2018-19 AND ONWARDS
GULBARGA UNIVERSITY, KALABURAGI

B. Sc. Mathematics Syllabus under Choice Based Credit System (CBCS)

Gulbarga University is proposed to introduce Choice Based Credit System (CBCS) for B. Sc. Programme from the academic year 2018 proposed syllabus has been prepared as per the guidelines issued by PMEB. The UG Board of Studies in Mathematics has prep approved this syllabus in its meeting held on 11.06.2018.

B.Sc. Mathematics Programme Course Matrix for Semester I–IV

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Title of the Course</th>
<th>Type of instruction &amp; hours per week/course</th>
<th>Credits</th>
<th>Hours of Exam(SEE) per Course/Sem.</th>
<th>Max. Marks for LA/Course/Sem.</th>
<th>Max. Marks for SEE per Course/Sem.</th>
<th>Max. Marks per Course/Sem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>BMDSC1T</td>
<td>Algebra-I and Calculus-I</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>BMDSC1P</td>
<td>Practical-I</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td>II</td>
<td>BMDSC2T</td>
<td>Real analysis-I and Calculus-II</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>BMDSC2P</td>
<td>Practical -2</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td>III</td>
<td>BMDSC3T</td>
<td>Algebra-II, Real Analysis-II and Calculus-III</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
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<tr>
<td></td>
<td>BMDSC3P</td>
<td>Practical -3</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>IV</td>
<td>BMDSC4T</td>
<td>Differential Equations</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
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<tr>
<td></td>
<td>BMDSC4P</td>
<td>Practical -4</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

BMDSC : B.Sc. Mathematics Discipline Specific Course

\[\text{Professor & Chairman} \]
\[\text{Department of Mathematics} \]
\[\text{Gulbarga University, KALABURAGI} \]
### B.Sc. Mathematics Programme Course Matrix for semester V-VI

**Discipline Specific Electives (DSE)**

*(Choose any One for each Semester)*

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course code</th>
<th>Code and Title</th>
<th>Type of instruction &amp; hours per week/course</th>
<th>Credits</th>
<th>Hours of Exam(SEE) per Course/Sem.</th>
<th>Max. Marks for LA/ Course/Sem.</th>
<th>Max. Marks for SEE per Course/Sem.</th>
<th>Max Marks per Course/Sem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>BMDSE5A</td>
<td>BMDSE5AT – Complex Analysis</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMDSE5AP – Practical-5 (A)</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
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</tr>
<tr>
<td></td>
<td>BMDSE5B</td>
<td>BMDSE5BT – Graph Theory-I</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
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<tr>
<td></td>
<td></td>
<td>BMDSE5BP – Practical-5 (B)</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
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<td>50</td>
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<tr>
<td></td>
<td>BMDSE5C</td>
<td>BMDSE5CT – Numerical Analysis-I</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>BMDSE5CP</td>
<td>BMDSE5CM – Practical-5 (C)</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td>VI</td>
<td>BMDSE6A</td>
<td>BMDSE6AT – Mathematical Analysis</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMDSE6AP – Practical-6 (A)</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMDSE6B</td>
<td>BMDSE6BT – Graph Theory-II</td>
<td>T 4</td>
<td>4</td>
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<tr>
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<td></td>
<td>BMDSE6BP – Practical-6 (B)</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMDSE6C</td>
<td>BMDSE6CT – Numerical Analysis-II</td>
<td>T 4</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMDSE6CP – Practical-6 (C)</td>
<td>P 4</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td>Sem.</td>
<td>Course code</td>
<td>Title</td>
<td>Type of instruction &amp; hours per week/course</td>
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<tr>
<td>V</td>
<td>BMSEC5A</td>
<td>Linear Programming Problems</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMSEC5B</td>
<td>Laplace Transforms</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
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<tr>
<td></td>
<td>BMSEC5C</td>
<td>Linear Algebra</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMSEC5D</td>
<td>Calculus of Variations</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>VI</td>
<td>BMSEC6A</td>
<td>Transportation and Assignment Problems</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMSEC6B</td>
<td>Fourier Series &amp; Harmonic Analysis</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMSEC6C</td>
<td>Boolean Algebra &amp; Lattices</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
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<tr>
<td></td>
<td>BMSEC6D</td>
<td>Vector Calculus</td>
<td>T 2</td>
<td>2</td>
<td>1 hr 30 min</td>
<td>10</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

Note: For practical's: Number of Students per batch per teacher: 15; Two teachers for a batch of 25 students

Professor & Chairman
Department of Mathematics
Gulbarga University, KALABURAGI
Course: BMDSC1T
ALGEBRA-I AND CALCULUS-I

Credits: 4 Max. Marks: 100 (SEE-80 + I.A.- 20) Total Lecture Hours: 60

Unit-1: Matrices
Recapitulation of Matrices, Symmetric and skew-symmetric matrices, Hermitian, Skew-Hermitian matrices, Orthogonal and unitary matrices and their properties, Rank of a Matrix, Reducing the matrix to the Echelon and normal form by using Elementary row and column operations. (Lecture hours-15)

Unit-2 : System of linear equations

Unit-3: Successive Differentiation
Successive differentiation, Formula for $n^{th}$ derivative of the following functions $e^{ax}, (ax+b)^n, \log (ax+b), \sin (ax+b), \cos (ax+b), e^{ax}\sin (bx+c) \text{ and } e^{ax}\cos (bx+c)$, Leibnitz’s theorem and applications.
Limits, continuity and bounds of a function, Algebra of continuous functions, Theorems on continuous functions (Every continuous function is bounded, Intermediate value theorem). (Lecture hours-15)

Unit-4 : Differentiability of functions
Differentiability of functions, Standard theorems including (Every differentiable function is continuous but not conversely), Rolle’s theorem, Lagrange’s Mean value theorem and Cauchy’s Mean value theorem, Taylor’s Theorem, Taylor’s and Maclaurin’s Series and related examples. Indeterminate forms (L-Hospital rule). (Lecture hours-15)

Books for Reference:
1) Matrices by Shanti Narayan
2) Matrices by M. Pille
3) Differential Calculus by Shanthi Narayan (S.Chand & Co.)
4) Advanced Calculus by Murry R Spiegel (Schaum Series)
5) Mathematical Analysis by S.C. Malik (Wiley Eastern)
6) Modern College Calculus by D.C. Pavate
7) UG Mathematics – I by Mahantesh S. Swamy

Course: BMDSCP
PRACTICALS-1

Credits: 2       Max. Marks: 50 (SEE-40 + IA-10)       Practical Hours: 4 /week

- Introduction to SciLab/ Maxima and commands related to the topic.
2. Computation of trace and transpose of matrices.
3. Computation of rank of matrix and row reduced echelon form.
5. Solution of system of equations (Homogeneous).
7. Finding $n^{th}$ derivative of $e^{ax}$, hyperbolic functions and trigonometric functions.
8. Finding $n^{th}$ derivative of algebraic functions.
9. Finding $n^{th}$ derivative of Logarithmic function.
10. Finding $n^{th}$ derivative of $e^{ax} \sin (ax+b)$, $e^{ax} \cos (ax+b)$.
11. Examples on Rolles theorem, Lagranges and Cauchy’s theorem.
12. Taylores and Maclaurin’s series expansion of a given function.

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and verify manually.


MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus problems. The latest version of this document can be found at http://maxim.sourceforge.net/documentation.html.

[Signature]
Professor & Chairman
Department of Mathematics
Gulbarga University, KALABURAGI
Course: BMDSC2T
REAL ANALYSIS-I AND CALCULUS-II

Credits: 4  Max. Marks: 100 ( SEE-80 + I.A.- 20)  Total Lecture Hours: 60

Unit-1: Sequences
Bounded and Unbounded sequences, Convergent, divergent and oscillatory sequences,
Monotonic Sequences, Theorems on sequences (Every convergent sequence has unique limit)
If \( \{x_n\} \) converges to \( l \) then \( \{|x_n|\} \) converges to \( |l| \), Every convergent sequence is bounded,
Sum, Difference, Product and Quotient of two convergent sequences is convergent, \((1+1/n)^n\) sequence converges the limit e.

(Lecture hours-15)

Unit-2: Infinite Series
Series of non-negative terms, geometric and \( p \)-series, Comparison test, De-Alembert’s Ratio
test, Raabe’s test and Cauchy’s root test. Alternating series, Leibnitz’s test (without proof),
Summation of series : exponential, logarithmic and binomial series and related examples.

(Lecture hours-15)

Unit-3: Functions of two and three variables
Limit and continuity, partial derivatives, homogenous functions, Euler’s theorem (up to second order), Total derivatives, Jacobian’s, Maxima and Minima for two variables.

(Lecture hours-15)

Unit-4: Integral Calculus
Reduction formula for \( \sin^n x, \cos^n x, \tan^n x, \sin^n x \cos^n x \) and \( \log x \) and examples
with limits. Applications of integration for finding length of arc for the curves (i) Parabola
from \( y = 0 \) to \( 2a \), (ii) Astroid, (iii) Cardiod from 0 to \( \pi \), (iv) Cycloid from 0 to \( \pi \), finding
surface area and volume of solid of revolution for standard curves : Parabola, Astroid,
Cardiod, Cycloid and Sphere.

(Lecture hours-15)

Books for Reference :
1) Modern Algebra : Vashistha
   Publishing House Pvt. Ltd.
3) Real Analysis : M. P. Bali
4) Real Analysis : Arora
5) Mathematical Analysis (Wiley, Eastern) : S.C. Malik

Professor & Chairman
Department of Mathematics
Gulbarga University, KALABURAGI
6) Introduction to Real Analysis; S Narayan and Raisighaniya
7) An Introduction to Sequences, Series; O.E. Stanics
8) Infinite Series, Mc. Millan Co.; Earl d. Rainville
9) Differential calculus by Shanti Narayan (S.Chand& Co.)
10) Integral Calculus by Shanti Narayan (S.Chand& Co.)
11) UG Mathematics – II by Mahantesh S. Swamy

Course: BMDSC2P

PRACTICALS-2

Credits: 2 Max. Marks: 50 (SEE-40 + IA-10) Practical Hours: 4/week

- Recapitulation of SciLab/Maxima commands related to the topic.
- Examining the convergence of sequences.
- Example on \( \lim_{n \to \infty} \left(1 + \frac{1}{n}\right)^n = e \)
- Verification of exponential series.
- Verification of Logarithmic series.
- Verification of binomial series.
- Example on convergence of series of positive terms.
- Examples on Cauchy’s Root test, Raabe’s and Ratio test.
- Examples on convergence of alternating series using Leibnitz theorem.
- Computation of arc length (Cartesian, Parametric and Polar form).
- Computation of surface area (Cartesian, Parametric and Polar form).
- Computation of Volume (Cartesian, Parametric and Polar form).
- Evaluation of definite integrals and Reduction formulae.

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and verify manually.


MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus problems. The latest version of this document can be found at http://maxima.sourceforge.net/documentation.html.

Professor & Chairman
Department of Mathematics
Gulbarga University, KALABURAGI
Course: BMDSC3T

ALGEBRA-II, REAL ANALYSIS-II AND CALCULUS-III

Credits: 4  Max. Marks: 100 ( SEE-80 + I.A.- 20)  Total Lecture Hours: 60

Unit-I: Groups
Definition of Groups and Sub-group and properties, Necessary and sufficient condition for a sub-group, Order of an element, Classification of sub-groups (i) Cyclic sub-groups, (ii) Cosets, (iii) normal sub-groups, Standard Theorems (Every cyclic group is abelian, Lagrange’s theorem, Euler’s theorem, Fermat’s theorem, Necessary and sufficient condition for normal sub-group).
Homomorphism, Isomorphism, Kernel of homomorphism with examples

(Lecture hours-15)

Unit-2: Riemann Integration
Lower and upper Riemann sums, Lower and upper Riemann integrals, Necessary and sufficient conditions for Riemann Integrability, Riemann integrals, Properties of Riemann-integrable functions (i) Upper R-Integral exceeds the lower R-Integral (ii) R-Integral lies between $m(b-a)$ and $M(b-a)$, R-Integrability of (i) continuous function (ii) monotonic function.

(Lecture hours-15)

Unit-3 : Fundamentals of Reimann Integral
Fundamental theorem of integral calculus, First and second mean value theorem of integral calculus. Leibnitz’s result to evaluate the examples of differentiation under the integral sign.

(Lecture hours-15)

Unit-4: Theory of Plane Curves
Polar co-ordinates, Angle between the radius vector and the tangent to the curves, length of the perpendicular from the pole to the tangent to the curve, pedal equation of the curves, whose equation is given in polar form with examples.
Curvature, Radius of curvature, Centre of curvature, Circle of curvature, Evolute and Involute, Envelops with related examples.

(Lecture hours-15)

Books for Reference :
1) Mathematical Analysis (Wiley, Eastern) : S.C. Malik
3) Differential calculus : Shanti Narayan (S.Chand& Co.)
4) College Mathematics Vol. I by N. Rudraiah (Sapna, Bangalore)
Course: BMDSC3P

PRACTICALS-3

Credits: 2  Max. Marks: 50 (SEE-40 + IA-10)  Practical Hours: 4 /week

2. Verifying the binary operations
3. Finding order of element of groups.
5. Verification of Lagranges theorem
6. Verification of Homomorphism and Isomorphism of Groups
7. Verification of Upper and lower Sums
8. Verification of Riemann integrals
9. Verification of Continuous functions.
10. Computation of angle between the radius vector and the tangent.
11. Tracing of Standard curves in 2D.
12. Tracing of Standard curves in 3D.

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and verify manually.


MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus problems. The latest version of this document can be found at http://maxim.sourceforge.net/documentation.html.

Professor & Chairman
Department of Mathematics
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Course: BMDSC4T
DIFFERENTIAL EQUATIONS

Credits: 4 Max. Marks: 100 (SEE-80 + I.A.- 20) Total Lecture Hours: 60

Unit-1: Ordinary Differential Equations
Differential equations of first order and higher degree: Equations solvable for p, x, y and Clairaut’s equations-General and singular solutions.
Higher order differential equations: Linear Differential Equation with constant coefficients, finding Complementary function and Particular integral (When RHS function is of the form $e^{\alpha x}$, $x^n$, $\sin \alpha x$, $\cos \alpha x$, $e^{\alpha t}V$, where $V$ is a function of $x$). (Lecture hours-15)

Unit-2: Linear Differential Equations
Linear Differential Equation with variable coefficients: Cauchy-Euler Differential Equations, Legendre-Linear differential equations, Solution of Second order Linear differential equations with variable coefficients by the method of Variation of parameters. (Lecture hours-15)

Unit-3: Total Differential equations
Integrability, Necessary condition for integrability, Conditions for exactness, Solution by inspection method. Simultaneous Differential Equations $\frac{dx}{F} = \frac{dy}{Q} = \frac{dz}{R}$ (Lecture hours-15)

Unit-4: Partial Differential Equations
Formation of partial differential equations, Lagrange’s equation $Pp + Qq = R$, First order non-linear partial differential equations and finding their complete integral by reducing to standard forms $f(p,q)=0$, $f(p,q,z)=0$, $f(x,p)=g(y,q)$, Clairaut’s form, Charpit’s method (without proof). (Lecture hours-15)

Books for Reference:
1) Introductory Course in Differential Equations : Daniel Morray
2) Engineering Mathematics : B. S. Grewal
3) Ordinary Differential Equation (Von-Norstand) : Charlton
4) Ordinary and Partial Differential Equation (S.Chand& Co) : Raisinghania M.D.
5) Differential Equation (TMH) : Simmons G.F.
6) Elements of Partial Differential Equations (McGraw Hill) : I.N. Sneddean
7) UG Mathematics – IV by Mahantesh S. Swamy
8) Differential Equations : F. Arays (Shau Series)
Course: BMDSC4P
PRACTICALS-4

Credits: 2  Max. Marks: 50 (SEE-40 + IA-10)  Practical Hours: 4/week

1. Solution of Differential equations which are solvable for \( x, y, p \).
2. To find singular solution by using Clairaut’s form.
3. Finding the C. F. of Linear differential equations with constant coefficients and plot the solutions.
5. Finding the P.I. of differential equations up to second order and plot the solutions.
7. Solution to the Total and simultaneous differential equations and plot the solutions.
8. Verification of exactness of a Differential Equations.
9. Verify Linear partial differential equation of the form \( Pp + Qq = R \).
10. Verifying first order non-linear partial differential equations (of the form \( f(p, q) = 0, f(p, q, z) = 0, f(x, p) = g(y, q) \), Clairaut’s form)
11. Verifying non-linear partial differential equation by Charpit’s method.
12. Solutions to standard forms \( f(p, q) = 0, f(p, q, z) = 0, f(x, p) = g(y, q) \).

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and verify manually.


MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus problems. The latest version of this document can be found at http://maxim.sourceforge.net/documentation.html.
Course: BMDSE5AT
COMPLEX ANALYSIS

Credits: 4  Max. Marks: 100 (SEE-80 + I.A.- 20)  Total Lecture Hours: 60

Unit-1: Complex variables
De-Moivre’s Theorem, Expansion of sine and cosine of multiple angles and powers of sin and cosine functions, Exponential form of complex numbers, Hyperbolic functions, Logarithms of complex quantities, Separation of expressions into real and imaginary parts.

(Lecture hours-15)

Unit-2: Functions of Complex Variables

(Lecture hours-15)

Unit-3: Complex Integration
Basic definitions, Cauchy’s integral theorem with examples, Cauchy’s integral formula, Evaluation of Contour Integrals by Cauchy’s integral formula, Derivatives of analytic function (Statements only), Cauchy’s Inequality, Liouville’s theorem

(Lecture hours-15)

Unit-4: Calculus of Residues
Residue at a pole, Residue at a pole of order $n>1$, Cauchy’s Residue Theorem, Evaluation of Contour Integrals by using Cauchy’s Residue Theorems.
Bilinear transformations by using Cross-ratio property with examples.

(Lecture hours-15)

Books for Reference:
1) Complex Analysis : J.N. Sharma.
2) Foundations of Complex Analysis,: Poncausamy, Narosa Publishing House
3) Complex Analysis : B.S. Tyagi
4) Complex Analysis : Dennis Zill and Patrick D.S.
5) Complex analysis : F. Ayres (Schaum’s Series)
5) UG Mathematics –V by Mahantesh S. Swamy
Course: BMDSE5AP
PRACTICALS-5(A)

Credits: 2  Max. Marks: 50 (SEE-40 + IA-10)  Practical Hours: 4 /week

1. Tracing of circles and straight lines.
2. Construction of analytic function when the real part of \( f(z) \) is given.
3. Construction of analytic function when the imaginary part of \( f(z) \) is given.
5. Verifying real and imaginary parts of analytic function being harmonic (i.e u and v satisfying the Laplace's equation).
6. Evaluation of contour integral by Cauchy’s integral formula and plot the solutions.
7. Evaluation of complex integrals when the point lies outside the cantor and plot the solution.
8. Computation of residues with simple poles.
9. Computation of residues when the pole m>1.
10. Evaluation of contour integrals by using Cauchy residue theorem – I
11. Evaluation of contour integrals by using Cauchy residue theorem – II

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MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus problems. The latest version of this document can be found at [http://maxima.sourceforge.net/documentation.html](http://maxima.sourceforge.net/documentation.html).
Course: BMDSE5BT

GRAPH THEORY-I

Credits: 4 Max. Marks: 100 ( SEE-80 + I.A.- 20) Total Lecture Hours: 60

Unit-1: Basic Concepts of Graphs
Introduction, graphs, finite and null graphs, loops, multi graphs, pseudo graph, simple graph, degree of a vertex, isolated and pendent vertices, connectedness and complete graphs, regular and complementary graphs, minimum and maximum degree, \( \sum \text{deg}(v) = 2q \). The number of vertices of odd degree is even. Isomorphism, line and total graphs (definitions and examples only).

(Lecture hours-15)

Unit-2: Sub-graphs
Sub-graphs, spanning and induced sub-graphs, walk, trial, path, cycle, the shortest path problems, bipartite graph. Characterization of bipartite graphs in terms of its cycles.

(Lecture hours-15)

Unit-3: Matrix Representation of Graph and Connectivity
Adjacency matrix, Incidence matrix and cycle matrices and rank of matrix, examples thereon. Verification of isomorphism by matrix method. Definition of a path of a matrix and examples.
Connectivity: Vertex and Edge connectivity – Separability, Whitney’s Inequality \( K(G) \leq \lambda (G) \leq \delta(G) \): Menger’s Theorem (Statement only).

(Lecture hours-15)

Unit-4: Trees
Cut Vertex, Bridge, Block, Trees, Spanning Tree, Rooted and Binary Trees, properties of trees and characterizations, forests, centres and centroids.

(Lecture hours-15)

Books for Reference:
1) Introduction to Graph Theory: U.K.: Robin J. Wilson, Longman (London),
2) Graph Theory and Applications: Narising Deo, (PHI), India.
3) Graph Theory: Frank Harrary, Narosa Publications
4) Graph Theory and Its Applications: D.S.Chandrashekharaiah.
5) Graph Theory and Its Applications: Vasudev.
6) Graph Theory: V. R. Kulli, Vishwa International Publications.
Course: BMDSE5BP
PRACTICALS-5(B)

Credits: 2  Max. Marks: 50 (SEE-40 + IA-10)  Practical Hours: 4 /week

1. Drawing of Simple, Pseudo and multiple graphs
2. Drawing of regular connected complete, complementary graphs.
3. Drawing of sub-graphs, Induced sub-graphs and spanning sub-graphs.
4. Drawing of bipartite, complete bipartite graphs.
5. Drawing of Walk, Trail, Path and Cycle.
6. Drawing of graph for Adjacency matrix and vise-versa.
7. Drawing of graph for Incidence matrix and vise-versa.
9. Finding the isomorphism of two graphs
10. Verification of graphs isomorphism by matrix method.
11. Draw Line graph for given graph.
12. Draw Total graph for given graph.

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and verify manually.


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Course: BMDSE5CT  
NUMERICAL ANALYSIS-I  

Credits: 4  
Max. Marks: 100 (SEE-80 + I.A.- 20)  
Total Lecture Hours: 60  

Unit-1: Solution of non-linear equations  
(Lecture hours-15)  

Unit-2: Solution of linear System of equations  
Solution of system of equations: Gauss Elimination method, Jacobi’s method, Gauss-Seidel method.  
(Lecture hours-15)  

Unit-3: Finite Differences  
Forward difference, backward difference, Shifting operator, Relation between $\Delta$, $\nabla$, $\nabla$.  
Difference table and $n^{th}$ differences of a polynomial.  
(Lecture hours-15)  

Unit-4: Interpolation  
Interpolation with equal intervals: Newton-Gregory forwarded and backward interpolation formulae, Interpolation with unequal intervals: Lagrange’s and Newton’s divided difference interpolation formula.  
(Lecture hours-15)  

Books for Reference:  
1) Numerical Analysis (Prentice Hall of India) : Shastry S.S.  
2) Numerical Analysis (Schaum’s Series) : Shield P.  
4) Computer Oriented Numerical Methods : (Prentice Hall of India), Rajaram V.  
5) Numerical Methods : (Tata McGraw Hill), Balaguruswamy E.  
7) Mathematics-VI : Mahantesh S. Swamy.  

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Course: BMDSE5CP
PRACTICALS-5(C)

Credits: 2 Max. Marks: 50 (SEE-40 + IA-10) Practical Hours: 4/week

1. Finding real roots by Bisection method correct up to three decimal places.
2. Finding real roots by method of false position correct up to three decimal places.
3. Finding real roots by Secant method correct up to three decimal places.
4. Finding real roots by Newton-Raphson method correct up to three decimal places.
5. Solution of system of equations by Gauss elimination method.
6. Solution of system of equation by Jacobi's method.
7. Solution of system of equation by Gauss-Seidal method.
8. Construction of difference table (forward, backward and central difference table).
10. Interpolation by using Newton-Gregories backward interpolation formula.
11. Interpolation by using Divided differences interpolation formula.
12. Interpolation by using Lagrange's interpolation formula.

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and verify manually.


MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus problems. The latest version of this document can be found at http://maxim.sourceforge.net/documentation.html.
Course: BMSEC5A
Linear Programming Problems

Credits: 2   Max. Marks: 50 (SEE-40 + I.A.- 10)   Total Lecture Hours: 30

Unit -1: Scope of O.R. and L.P.P.
Definition of OR, Scope and application of OR, Models of OR.
Definition of LPP, formulation of LPP, standard mathematical model of LPP, basic feasible solutions, degenerate and non-degenerate basic feasible solution, examples of basic solutions which are not feasible, convex sets, supporting and separating hyper planes, simplex.

(Lecture hours-15)

Unit -2: Solution of LPP
Graphical method, Simplex method, slack and surplus variables, Big-M method, duality in linear programming problem.

(Lecture hours-15)

Books for Reference:
1) Operation Research :S.D. Sharma.
3) Operation Research : Kanti Swaroop, P.K. Gupta and Manmohan, S.Chand & Son’s (1994)

Course: BMSEC5B
Laplace Transforms

Credits: 2   Max. Marks: 50 (SEE-40 + I.A.- 10)   Total Lecture Hours: 30

Unit -1: Introduction to Laplace transform

(Lecture hours-15)

Unit-2 :Applications of Laplace transform.
Convolution theorem (only statement) and related examples. Laplace Transform of derivatives, applications of Laplace transforms to solve differential equations up to second order.

(Lecture hours-15)
Books for Reference:

1) Laplace Transform: (Schaum's Series), Murry R. Spiegel L.
2) Laplace Transforms: Goel and Gupta.
4) Mathematical Physics: Satya Prakash.
5) Higher Engineering Mathematics: B.S. Grewal
6) Mathematics-IV: Mahantesh S. Swamy

Course: BMSEC5C
Linear Algebra

Credits: 2 Max. Marks: 50 (SEE-40 + I.A.-10) Total Lecture Hours: 30

Unit-1: Vector Space
Definition of Vector space, properties and examples of vector space, Vector subspace. Linear combination and Linear span of a set, Linear dependence and Linear independence. Basis and Dimension.

(Lecture hours-15)

Unit-2: Linear transformation
Linear transformation, properties of linear transformation, range, null space, rank and nullity theorem and related examples.

(Lecture hours-15)

Books for Reference:

1) Topics in Algebra: I.N. Herstein.
2) A. First course in Abstract Algebra: Fraleigh J.B.
3) Linear Algebra: (Schaum's Series), Lipschitz S.
4) Topics in Algebra: Vijaykumar and Bambari.
5) Mathematics-IV: Mahantesh S. Swamy

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Course: BMSEC5D
Calculus of Variations

Credits: 2  Max. Marks: 50 ( SEE-40 + L.A.- 10)  Total Lecture Hours: 30

Unit-1:
Variation of a function \( f = f(x, y, y') \) – variation of the corresponding functional external of a functional – variational problem. Euler’s equation and its particular forms – Examples.

(Lecture hours-15)

Unit-2:
Standard problems like geodesics minimal surface of revolution, hanging chine – Brachistochrone problem – Isoperimetric problems.

(Lecture hours-15)

Books for Reference:
1) Calculus of Variations : G.K. Ranganath
2) Mathematical Physics : B.D. Gupta
3) Mathematics-VI : Mahantesh S. Swamy.
Course: BMDSE6AT
Mathematical Analysis

Credits: 4  Max. Marks: 100 (SEE-80 + I.A.- 20)  Total Lecture Hours: 60

Unit-1: Line and Multiple Integrals
Line integrals along plane and space curves, Double integrals, Change of order, Change of
variables, changing into polar coordinates, Triple integrals, over the given region.
(Lecture hours-15)

Unit-2: Improper Integrals
Improper Integrals of the first and second kinds, Convergence (simple examples), Beta and
Gamma functions, Applications to evaluate the standard integrals, relations between Beta and
Gamma functions, Duplication formula, Sterling formula (statements only)
(Lecture hours-15)

Unit-3: Legendre Differential Equation:
Legendre Polynomials P_n^(x) as a solution, Rodrigue's Formula – generating function,
Orthogonal property and basic recurrence relation and examples related to the recurrence
relations
(Lecture hours-15)

Unit-4: Bessel's Differential Equation:
Bessel’s Differential Equation, Bessel function, J_n(x) as a solution – generating formula –
integral formula for J_n(x), Orthogonal property – basic recurrence relation and examples
related to the recurrence relations.
(Lecture hours-15)

Books for Reference:
1) Real Analysis: Sharma and Vasistha, (Krishna PrakashanMandir, Merruit).
2) Mathematical Analysis: Shantinarayan, (S.Chand& Co.)
3) Ordinary Differential Equation: Charlton, (Von-Norstand).

Professor & Chairman
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Course: BMDSE6AP
PRACTICALS-6(A)

Credits: 2  Max. Marks: 50 (SEE-40 + I.A.-10)  Total Lecture Hours: 30

1. Evaluation of double integrals with constant limits over the given region when the
   integrand is unity (i.e., finding the area).
2. Evaluation of double integrals with variable limits over the given region when the
   integrand is unity (i.e., finding the area).
3. Evaluation of triple integrals with constant limits over the given region when the
   integrand is unity (i.e., finding the volume).
4. Evaluation of triple integrals with variable limits over the given region when the
   integrand is unity (i.e., finding the volume).
5. Verification of given integral for its convergence – Algebraic function.
6. Verification of given integral for its convergence – Logarithmic and exponential
   function.
7. Verification of given integral for its convergence – Trigonometric function.
8. Evaluation of $\Gamma(n)$ for $n$ is integer.
9. Evaluation of $\Gamma(n)$ for $n$ is non-integer.
10. Evaluation of $\beta(m,n)$ for any $m$ and $n > 0$.
11. Recurrence relation for Legendre’s function.
12. Recurrence relation for Bessel’s function.

Note: Use the MAXIMA/SciLab Open-source Software to execute the Practical problems and
verify manually.

SciLab: It can be downloaded from http://www.scilab.org/download. some materials for scilab can
be found on http://wiki.scilab.org/Tutorialssources.

MAXIMA: MAXIMA is an open source computer algebra system for solving typical calculus
problems. The latest version of this document can be found at
Course: BMDSE6BT

GRAPH THEORY-II

Credits: 4  Max. Marks: 100 (SEE-80 + I.A.-20)  Total Lecture Hours: 60

Unit-1: Eulerian and Hamiltonian Graphs:
Introduction. The Königsberg Bridge problem and traveling salesman problem.
Characterization of Eulerian Graph and properties of Hamiltonian graphs. Some applications
of graphs in electric networks.  

(Lecture hours-15)

Unit-2: Planar Graphs
Plane and Planar graphs, Euler's formula, outer planar graphs, Kuratowski's Theorem - Other
characterization of planar graphs – Crossing numbers (examples)

(Lecture hours-15)

Unit-3: Colorability
Introduction, coloring of a graph, chromatic numbers of some of the familiar graphs, Four
color conjecture.

(Lecture hours-15)

Unit-4: Directed Graphs:
Digraphs, Eulerian digraphs, kinds of digraphs, strong and weak digraphs, condensation of
digraphs, tournaments.

(Lecture hours-15)

Books for Reference:
1) Introduction to Graph Theory: Longman (London), U.K., Robin J. Wilson.
2) Graph Theory and Applications: (PHI), India, Narsing Deo.
3) Graph Theory: Narosa Publications, Frank Harrary.
4) Graph Theory and Its Applications: DSC
5) Graph Theory with Applications: New Age International Publishers, C. Vasudev.
6) Graph Theory: Vishwa International Publications, V.R. Kulli.
7) Graph Theory and its applications: Balkrishan.
Course: BMDSE6BP

PRACTICALS-6(B)

Credits: 2  Max. Marks: 50 (SEE-40 + I.A.- 10)  Total Lecture Hours: 30

1. Drawing different types of trees, spanning tree rooted and binary trees.

2. Determination of the cut-vertex, bridge and blocks.

3. Determination of vertex connectivity.

4. Determination of edge connectivity.

5. Verification of Whitney's inequality for different graphs.


7. Drawing of non-Eulerian graphs.


10. Drawing of planar and non-planar graphs.

11. Colorability of graphs.

12. Finding chromatic number for a given graphs.

Note: Use the **MAXIMA/SciLab** Open-source Software to execute the Practical problems and verify manually.


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24
Course: BMDSE6CT
NUMERICAL ANALYSIS-II

Credits: 4       Max. Marks: 100 ( SEE-80 + I.A.- 20)       Total Lecture Hours: 60

Unit-1: Numerical Differentiation
Numerical differentiation using forwarded and backward difference formulae – computation of first and second derivatives.

(Lecture hours-15)

Unit-2: Numerical Integration
General Quadrature formula - Trapezoidal rule, Simpsons 1/3 rd and 3/8th rules, Weddles Rule

(Lecture hours-15)

Unit-3: Solution of IVP
Solutions of initial value problem for ordinary linear first order differential equations by Picard’s, Taylor’s, Euler’s, Euler’s modified method, and Runge - Kutta Methods of order 2 and 4.

(Lecture Hours – 15)

Unit-4: Predictor-corrector methods:
Adams-Bashforth Predictor-Corrector method and Milne Predictor-Corrector method. Finite difference method, shooting method

(Lecture hours-15)

Books for Reference:
2) Numerical Analysis : Shield P. , (Schaum’s Series).
7) Mathematics-VI :: Mahantesh S. Swamy.
Course: BMDSE6CP
PRACTICALS-6(C)

Credits: 2  Max. Marks: 50 ( SEE-40 + I.A.- 10)  Practical Hours: 4/Week

1. Determination of derivative of a function at the given point using numerical differentiation formula.


7. Solution of Initial Value Problem by Taylor’s method.

8. Solution of Initial Value Problem by Euler’s modified method.


10. Solution of Initial Value Problem by R-K Fourth order method.


12. Solution of Initial Value Problem by Milne’s Predictor-Corrector method.

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Course: BMSEC6A
TRANSPORTATION AND ASSIGNMENT PROBLEMS

Credits: 2    Max. Marks: 50 (SEE-40 + I.A.- 10)    Total Lecture Hours: 30

Unit-1 : Transportation problems

Introduction, Mathematical formation, existence of feasible solutions, transportation table, initial basic feasible solution: North-west corner method, row minimamethod, column minim method, matrix minima method, Vogel’s approximation method, transportation algorithm.  

(Lecture hours-15)

Unit-2 : Assignment problem


(Lecture hours-15)

Books for Reference:

1) Operation Research : S.D. Sharma.
2) Operation Research : KantiSwaroop.

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Course: BMSEC6B

FOURIER SERIES AND FOURIER TRANSFORMS

Credits: 2  
Max. Marks: 50 (SEE-40 + L.A.- 10)  
Total Lecture Hours: 30

Unit-1: Fourier’s Series
Introduction, period functions, Trigonometric series, Euler’s formula, Fourier’s series of period 2π, 2L and arbitrary period. Fourier series of even and odd functions. Half range Fourier series.

(Lecture hours-15)

Unit-2: Fourier Transforms

(Lecture hours-15)

Books for Reference:
1) Fourier Series and Fourier transform: (Schaum’s series), Murry R & Spiegel.
2) Fourier Series & Boundary Value Problem: (McGrew Hill), Churchil R. V & Brown J.W.
3) S.P. Series-Mathematics-IV: Mahantesh S. Swamy.

[Signature]
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Course: BMSEC6C
LATTICES AND BOOLEAN ALGEBRA

Credits: 2  Max. Marks: 50 (SEE-40 + I.A.- 10)  Total Lecture Hours: 30

Unit-1: Lattices
Definition, Properties, Bounded Lattices, Sub-lattices, Distributive Lattices, Complements, Complemented Lattices, Isomorphism and Isomorphic Lattices.

(Lecture hours - 15)

Unit-2: Boolean Algebra
Introduction, operator, definition, principle of Duality, fundamental theorems on Boolean Algebra, relation, Boolean function, Disjunctive normal form, Conjunctive normal form, Conversion.
Switching Circuits: Switching and Boolean function.

(Lecture hours - 15)

Books for Reference:
1) Elements of discrete Mathematics: Liu C.L.
3) S.P. Series-Mathematics-II: Mahantesh S. Swamy.
Course: BMSEC6D
VECTOR CALCULUS

Credits: 2  Max. Marks: 50 ( SEE-40 + I.A.-10)  Total Lecture Hours: 30

Unit-1 : Vector Differentiation
Scalar point function, Scalar field, Vector point function, Vector field, gradient of scalar point function, gradient in terms of position vectors, divergences and curl of a vector field, solenoidal and irrotational vector, Laplacian of a scalar field.

(Lecture hours-15)

Unit-2 : Vector Integration :
Green's theorem in the plane, direct consequences of the theorem, the Gauss divergence theorem (without proof), direct consequences of the theorem, the Stoke's theorem (Statement only), direct consequences of the theorem.

(Lecture hours-15)

Books for Reference :
1) Vector Analysis : (Schaum's Series), Murry R & Spiegal L.
2) Vector Analysis : Spain B.
3) S.P. Series-Mathematics-IV : Mahantesh S. Swamy

Professor & Chairman
Department of Mathematics
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## Question Paper Pattern for all the Semester

Max. Marks : 80  
Time : 3 Hrs

<table>
<thead>
<tr>
<th>I.</th>
<th>Answer any ten questions</th>
<th>10 x 2 =20</th>
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<tbody>
<tr>
<td>Question No.</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>1-3</td>
<td>Unit-1</td>
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<tr>
<td>4-6</td>
<td>Unit-2</td>
<td></td>
</tr>
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<td>7-9</td>
<td>Unit-3</td>
<td></td>
</tr>
<tr>
<td>10-12</td>
<td>Unit-4</td>
<td></td>
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<tr>
<th>II.</th>
<th>Answer any three questions</th>
<th>3 x 5 =15</th>
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</thead>
<tbody>
<tr>
<td>1-4</td>
<td>Unit-1</td>
<td></td>
</tr>
</tbody>
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<tr>
<th>III.</th>
<th>Answer any three questions</th>
<th>3 x 5 =15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>Unit-2</td>
<td></td>
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<tr>
<th>IV.</th>
<th>Answer any three questions</th>
<th>3 x 5 =15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>Unit-3</td>
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<tr>
<th>V.</th>
<th>Answer any three questions</th>
<th>3 x 5 =15</th>
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</thead>
<tbody>
<tr>
<td>1-4</td>
<td>Unit-4</td>
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## Question Paper Pattern for V & VI Semester

Max. Marks : 40  
Time : 1 hr 30 min

<table>
<thead>
<tr>
<th>I.</th>
<th>Answer any five questions</th>
<th>5 x 2 =10</th>
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<tbody>
<tr>
<td>Question No.</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>1-3</td>
<td>Unit-1</td>
<td></td>
</tr>
<tr>
<td>4-6</td>
<td>Unit-2</td>
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<th>II.</th>
<th>Answer any three questions</th>
<th>3 x 5 =15</th>
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</thead>
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<td>1-4</td>
<td>Unit-1</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>III.</th>
<th>Answer any three questions</th>
<th>3 x 5 =15</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Unit-2</td>
<td></td>
</tr>
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