HINDI MAHAVIDYALAYA

(AUTONOMOUS)

NALLAKUNTA, HYDERABAD - 44.

NAAC RE-ACCREDITED

B.Sc IInd YEAR

DEPARTMENT OF MATHEMATICS

2017-2018

HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
(AUTONOMOUS)
BOARD OF STUDIES
DEPARTMENT OF MATHEMATICS

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Head – Department of Mathematics
Hindi Mahavidyalaya
Nallakunta, Hyderabad.

University Nominee
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Ex-Officio Member – BOS
Department of Mathematics
Osmania University, Hyderabad.

Prof. M.V. Ramana Murthy
Chairman
BoS in Mathematics
Department of Mathematics
Osmania University,
Hyderabad-500007.

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   Head - Department of Mathematics
   Osmania University, Hyderabad

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Hyderabad - 500 007

2. Smt. Arun Jyothi
   Andhra Mahila Sabha
   Arts & Science College
   Osmania University, Hyderabad

3. Dr. Padma Anuradha
   Govt. Women's College
   Mathematics Department, Begumpet

ALUMNI'S

Dr. Alka Mashalkar
Associate Professor, Mathematics
Osmania University, Hyderabad

11/7/2017

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COMPOSITION OF THE BOARD OF STUDIES IN AN AUTONOMOUS COLLEGE

I. **Composition: Department of Mathematics**

1. Head of the department concerned (Chairperson)
   - Mrs. Shravanti Vanga – Department of Mathematics

2. The entire faculty of each specialization.
   Mrs. Shravanti Vanga

3 One expert to be nominated by the vice-chancellor from a panel if six recommended by the College Principal.

1. Prof. M. V. Ramana Murthi, Ex-Officio Member, BOS, Dept. of Mathematics

4. Experts in the subject from outside the college to be nominated by the Academic Council.
   1. Dr. J. Anand RAo, Head of Mathematics Department, Osmania University, Hyderabad.
   2. Smt. Arun Jyothi, Mathematics Department, Andhra Mahila Sabha Arts & Science College, Hyderabad.
   3. Dr. Padma Anuradha, Govt. Women's College, Mathematics Department, Begumpet.

5. One postgraduate meritorious alumnus to be nominated by the Principal. The chairman, Board of Studies, may with the approval of the Principal of the College.
   1. Dr. Alka Mashalkar, Associate Professor, Mathematics, Osmania University, Hyderabad.

(a) Experts from outside the College whenever special courses of studies are to be formulated-To be nominated.

(b) Other members of staff of the same faculty.

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2.4 Marks allotted for Internal and End Semester exams.

1. Internal assessment is of 20 marks. (15M for Internal + 5 M for assignment).In each Semester two internal assessment of 15 Marks will be conducted and an average of both the internal assessments will be added in the marks of Theory exam.
2. Theory Question paper is of 80 marks.
3. Total allotted marks are 100.
4. Internal assessment is of 10 marks for SEC. One internal assessment of 10 Marks will be conducted and added in the marks of Theory exam.
5. Theory Question paper for SEC is of 40 marks.
6. Total allotted marks are 50 for SEC.

The distribution of marks was approved by the Member of BOS.

2.5 Discussion on Pattern and Model Paper of Semester exam and Model Paper of Internal Exam

1. It was informed by the department that in each Semester Two Internal exams will be conducted for 15 marks and 5 marks will be allotted for assignment. Average of marks of these two internal exams will be taken.
2. Semester exam will be conducted as per the Almanac which will be provided by the exam branch. Internal exam duration will be 30Mts and Semester exam duration will be of 3 hrs.
3. Model Question paper for Semester III and Semester IV was discussed. Theory paper for each Semester will have 2 sections.
   i) Section A contains 8 short Questions. The student has to answer four questions. Each Question carries 5 Marks (4X5=20 Marks)
   ii) Section B contains 4 Essay type Questions with internal choice. Each Question carries 15 Marks (4X15=60 Marks)
4. Model Question paper for SEC Semester III and Semester IV was discussed. Theory paper for each SEC will have 2 sections.
   i) Section A contains 2 short Questions. The student has to answer TWO questions. Each Question carries 5 Marks (2X5=10 Marks)
   ii) Section B contains 2 Essay type Questions with internal choice. Each Question carries 15 Marks (2X15=30 Marks)

- Pattern of Model Theory Question Papers for Paper III and Paper IV are enclosed.
- Pattern of Model Theory Question Papers was approved by Member of BOS.

2.6 Discussion on Practical Exam Model paper.

It was decided in BOS meeting that 50 Marks Practical Exam of 3 hrs will be held in each Semester and 1 credit will be given for Practical in each Semester.

- Pattern of Model Practical Question Papers for Paper III and Paper IV are enclosed.
- Pattern of Model Practical Question Papers was approved by Member of BOS.

2.7 Panel of Examiners

The panel of examiners was approved by the members.

- List is enclosed

2.8 Any other matter.

1. It has been suggested to add one hour more for practicals.
2. It is resolved to recommend the examiner for setting the question paper by choosing at least one question from each unit in section A.
3. It is resolved to follow that the practical examinations held for B.Sc first years from the academic year 2017-18 onwards will have the pattern of 25 marks scheme and the credits will remain the same i.e. 1 credit. The duration of the exam will be 2 hours.

2.9 Vote of Thanks

Meeting concluded with the Vote of Thanks by Mrs. Shravanti Vanga.

Chairperson

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University Nominee

Members

PRINCIPAL
HINDI MAHAVIDYALAYA
Arts, Commerce & Science
(Autonomous)
NALLAKUNTA, HYD-44

1. K. ArunJyothi
2. V. Padma Anuradha
3. Dr. J. Anand Rao
4.

Head
Department of Mathematics
Osmania University
Hyderabad - 500007

4/7/17

DEPARTMENT OF MATHETHAMICS
AGENDA OF THE MEETING
TUESDAY 11/07/2017

2.1 Welcome address by the chair.

2.2 Details of choice base credit system.

2.3 Discussion on Common Core Syllabus of III Semester and IV Semester

2.4 Marks allotted for Internal and end Semester exams for III Semester and IV Semester

2.5 Discussion on Semester Exam, Semester Exam Model Paper & Internal Exam Model Paper for III Semester and IV Semester

2.6 Discussion on Practical Exam Model Paper

2.7 Panel of Examiners

2.8 Any other matter

2.9 Vote of Thanks

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2017-18 CBCS STRUCTURE

B.SC. M P CS / M S CS

FIRST YEAR SEMESTER-I					Semester End exam		Continuous Internal Evaluation			
Code	Course Title	Course Type	HPW	Credits	Duration In HRS	Marks	Exam Duration	Marks	Total	Practical 3 HRS
BS101	Environmental Studies	AECC-1	2	2	2	40	30 min	10	50	-
BS102	English	CC-1A	5	5	3	80	30 min	20	100	-
BS103	Second Language (H/ S/ T)	CC –2A	5	5	3	80	30 min	20	100	-
BS104	MATHS	DSC-1A	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	25
BS105	PHYSICS / STATISTICS	DSC-2A	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	25
BS106	COMPUTER SCIENCE	DSC-3A	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	25
	TOTAL NO. OF CREDITS			27		440		110	625	

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2017-18 CBCS STRUCTURE

B.SC. M P CS / M S CS

SECOND YEAR SEMESTER-III					Semester End exam		Continuous Internal Evaluation		Total	Practical 3 HRS
Code	Course Title	Course Type	HPW	Credits	Duration in HRS	Marks	Exam Duration	Marks		
BS301	A/B	SEC-1	2	2	2	40	30 min	10	50	-
BS302	English	CC-1C	5	5	3	80	30 min	20	100	-
BS303	Second Language	CC-2C	5	5	3	80	30 min	20	100	-
BS304	MATHS	DSC-1C	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
BS305	PHYSICS / STATISTICS	DSC-2C	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
BS306	COMPUTER SCIENCE	DSC-3C	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
			30	27		440		110	700	

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B.SC. M P CS / M S CS

SECOND YEAR SEMESTER-III					Semester End exam		Continuous Internal Evaluation		Total	Practical 3 HRS
Code	Course Title	Course Type	HPW	Credits	Duration In HRS	Marks	Exam Duration	Marks		
BS301	A/B	SEC-1	2	2	2	40	30 min	10	50	-
BS302	English	CC-1C	5	5	3	80	30 min	20	100	-
BS303	Second Language	CC-2C	5	5	3	80	30 min	20	100	-
BS304	MATHS	DSC-1C	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
BS305	PHYSICS / STATISTICS	DSC-2C	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
BS306	COMPUTER SCIENCE	DSC-3C	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
			30	27		440		110	700	

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2017-18 CBCS STRUCTURE

B.SC. M P CS / M S CS

SECOND YEAR SEMESTER-IV					Semester End exam		Continuous Internal Evaluation		Total	Practical 3 HRS
Code	Course Title	Course Type	HPW	Credits	Duration in HRS	Marks	Exam Duration	Marks		
BS401	C/D	SEC-2	2	2	2	40	30 min	10	50	-
BS402	English	CC -1D	5	5	3	80	30 min	20	100	-
BS403	Second Language	CC-2D	5	5	3	80	30 min	20	100	-
BS404	MATHS	DSC-1D	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
BS405	PHYSICS / STATISTICS	DSC-2D	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
BS406	COMPUTER SCIENCE	DSC-3D	4 T + 2P = 6	4+1=5	3	80	30 min	20	100	50
			30	27		440		110	700	

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2017-18 CBCS STRUCTURE

SEC: Skill Enhancement Course for Semester III & IV

Code	Course Title	Course	Course Type	Department	HPW	Credits	Semester End exam: Duration in HRS	Semester End exam: Marks	Continuous Internal Evaluation: Exam Duration	Continuous Internal Evaluation: Marks	Total Marks
BA301	Legislative Practices and Procedures	B.A	SEC-1	Political Science	2	2	2	40	30 Min	10	50
BA401	Laws, Duties and Rights of Citizens	B.A	SEC-2	Political Science	2	2	2	40	30 Min	10	50
BA301	Historical and Cultural Tourism in India	B.A	SEC-1	History	2	2	2	40	30 Min	10	50
BA401	Archives and Museums	B.A	SEC-2	History	2	2	2	40	30 Min	10	50
BC301	Principles of Insurance	B.Com.	SEC-1	Commerce	2	2	2	40	30 Min	10	50
BC401	Practice of life insurance	B.Com.	SEC-2	Commerce	2	2	2	40	30 Min	10	50
BS301	Computational Biochemistry	B.Sc. (LS)	SEC-1	Biochemistry	2	2	2	40	30 Min	10	50
BS401	Medical Lab Technology	B.Sc. (LS)	SEC-2	Biochemistry	2	2	2	40	30 Min	10	50
BS301	Haematology	B.Sc. (LS)	SEC-1	Microbiology	2	2	2	40	30 Min	10	50
BS401	Food Adulteration	B.Sc. (LS)	SEC-2	Microbiology	2	2	2	40	30 Min	10	50
BS301	A: SciLab – 1	B.Sc. (PS)	SEC–1	Computer Science	2	2	2	40	30 Min	10	50
	B: Boolean Algebra	B.Sc. (PS)	SEC–1	Computer Science	2	2	2	40	30 Min	10	50
BS401	C: SciLab – 2	B.Sc. (PS)	SEC–2	Computer Science	2	2	2	40	30 Min	10	50
	D: Digital Logic	B.Sc. (PS)	SEC–2	Computer Science	2	2	2	40	30 Min	10	50
BS301	Logic and Sets	B.Sc. (PS)	SEC-1A	Mathematics	2	2	2	40	30 Min	10	50
	Theory of Equations	B.Sc. (PS)	SEC-1B	Mathematics	2	2	2	40	30 Min	10	50
BS401	Transportation and Game Theory	B.Sc. (PS)	SEC-2C	Mathematics	2	2	2	40	30 Min	10	50
	Number Theory	B.Sc. (PS)	SEC-2D	Mathematics	2	2	2	40	30 Min	10	50
BS301	Concepts of Sequences of Random Variables	B.Sc. (PS)	SEC-1	Statistics	2	2	2	40	30 Min	10	50
BS401	Statistics for Psychology and Education	B.Sc. (PS)	SEC-2	Statistics	2	2	2	40	30 Min	10	50

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(AUTONOMOUS)
B.Sc. II[nd] Year Mathematics
Semester – III
Paper III

Code: BS304	
Instruction	
Theory Classes	**4 Hrs/Week**
Practical Classes	**2 Hrs/Week**
Credit for Theory	**4**
Credit for Practical	**1**
Duration of Semester Examination	**3 Hrs**
Duration of Internal Examination	**30 Min**
Semester Examination Marks	**80 Marks**
Internal Examination Marks	**15 Marks**
Assignment Marks	**05 Marks**

REAL ANALYSIS

DSC-1C **BS:304**

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

Outcome: After the completion of the course students will be in a position to appreciate beauty and applicability of the course.

Unit- I

Sequences: Basic Terminology, Sequences Bounded above, Sequences bounded below, Bounded Sequences Limits of Sequences- A Discussion about Proofs-Limit Theorems for Sequences-Monotone Sequences and Cauchy Sequences.

Unit- II

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

Unit- III

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

Unit- IV

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

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Text Book: Kenneth A Ross, Elementary Analysis-The Theory of Calculus

References Books:

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

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(AUTONOMOUS)
B.Sc. IInd Year Mathematics
Semester – III
Practical Paper- III

Code: BS304	
Instruction	**2 Hrs / Week**
Duration of Exam	**3 Hrs**
Marks for Exam	**50 Marks**

Real Analysis

Unit-I

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

   (a) $a_n = \frac{n}{n+1}$ (b) $b_n = \frac{n^2+3}{n^2-3}$

   (c) $c_n = 2^{-n}$ (d) $t_n = 1 + \frac{2}{n}$

   (e) $x_n = 73 + (-1)^n$ (f) $s_n = (2)^{\frac{1}{n}}$

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

   (a) $a_n = \frac{n}{n^2+1}$ (b) $b_n = \frac{7n-19}{3n+7}$

   (c) $c_n = \frac{4n+3}{7n-5}$ (d) $d_n = \frac{2n+4}{5n+2}$

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

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

   (a) Show if $a = \lim x_n$, then $a = \frac{1}{3}$ or $a = 0$.

   (b) Does $\lim x_n$ exist? Explain.

   (c) Discuss the apparent contradiction between parts (a) and (b).

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

   (a) $\frac{1}{n}$ (b) $\frac{(-1)^n}{n^2}$

   (c) n^5 (d) $\sin(\frac{n\pi}{7})$

   (e) $(-2)^n$ (f) $\frac{n}{3^n}$

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

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

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

(a) Show $\lim t_n$ exists.

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

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

(a) Show $\lim t_n$ exists.

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

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

(d) Repeat part (b).

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

(a) Find s_2, s_3 and s_4.

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

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

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

Unit-II

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

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

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

12. Consider the sequences defined as follows:

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

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

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

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

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

(e) Which of the sequences is bounded?

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

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

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

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

Find

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

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

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

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

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26. Let $f_n(x) = \frac{n+\cos x}{2n+\sin^2 x}$ for all real numbers x.

(a) Show (f_n) converges uniformly on $\mathbb{R}$. Hint: First decide what the limit function is, then show (f_n) converges uniformly to it.

(b) Calculate $\lim_{n\to\infty} \int_2^7 f_n(x)dx$. Hint: Don't integrate f_n.

27. Show $\sum_{n=1}^{\infty} \frac{1}{n^2} \cos nx$ converges uniformly on $\mathbb{R}$ to a continuous function.

28. Show $\sum_{n=1}^{\infty} \frac{x^n}{n^2 2^n}$ has radius of convergence 2 and the series converges uniformly to a continuous function on $[-2, 2]$.

29. (a) Show $\sum \frac{x^n}{1+x^n}$ converges for $x \in [0, 1)$

(b) Show that the series converges uniformly on $[0, a]$ for each a, $0 < a < 1$.

30. Suppose $\sum_{k=1}^{\infty} g_k$ and $\sum_{k=1}^{\infty} h_k$ converge uniformly on a set S. Show $\sum_{k=1}^{\infty}(g_k + h_k)$ converges uniformly on S.

UNIT-IV

31. Let $f(x) = x$ for rational x and $f(x) = 0$ for irrational x.

(a) Calculate the upper and lower Darboux integrals for f on the interval $[0, b]$.

(b) Is f integrable on $[0, b]$?

32. Let f be a bounded function on $[a, b]$. Suppose there exist sequences (U_n) and (L_n) of upper and lower Darboux sums for f such that $\lim(U_n - L_n) = 0$. Show f is integrable and $\int_a^b f = \lim U_n = \lim L_n$.

33. A function f on $[a, b]$ is called a step function if there exists a partition $P = \{a = u_0 < u_1 < ... < u_m = b\}$ of $[a, b]$ such that f is constant on each interval (u_{j-1}, u_j), say $f(x) = c_j$ for x in (u_{j-1}, u_j).

(a) Show that a step function f is integrable and evaluate $\int_a^b f$.

(b) Evaluate the integral $\int_0^4 P(x)dx$ for the postage-stamp function.

34. Show $|\int_{-2\pi}^{2\pi} x^2 \sin^8(e^x)dx| \leq \frac{16\pi^3}{3}$.

35. Let f be a bounded function on$[a, b]$, so that there exists $B > 0$ such that $|f(x)| \leq B$ for all $x \in [a, b]$.

(a) Show

$$U(f^2, P) - L(f^2, P) \leq 2B[U(f, P) - L(f, P)]$$

for all partitions P of $[a, b]$. Hint: $f(x)^2 - f(y)^2 = [f(x) + f(y)].[f(x) - f(y)]$

(b) Show that if f is integrable on $[a, b]$, then f^2 also is integrable on $[a, b]$.

36. Calculate

(a) $\lim_{x\to 0} \frac{1}{x} \int_0^x e^{t^2} dt$

(b) $\lim_{h\to 0} \frac{1}{h} \int_3^{3+h} e^{t^2} dt$.

37. Show that if f is a continuous real-valued function on $[a, b]$ satisfying $\int_a^b f(x)g(x)dx = 0$ for every continuous function g on $[a, b]$, then $f(x) = 0$ for all x in $[a, b]$.

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(e) $\limsup s_n + \limsup t_n$,

(f) $\liminf(s_n t_n)$,

(g) $\limsup(s_n t_n)$.

15. Determine which of the following series converge. Justify your answers.

(a) $\sum \frac{n^4}{2^n}$

(b) $\sum \frac{2^n}{n!}$

(c) $\sum \frac{n^2}{3^n}$

(d) $\sum \frac{n!}{n^4+3}$

(e) $\sum \frac{\cos^2 n}{n^2}$

(f) $\sum_{n=2}^{\infty} \frac{1}{\log n}$

16. Prove that if $\sum a_n$ is a convergent series of nonnegative numbers and $p > 1$, then $\sum a_n^p$ converges.

17. Show that if $\sum a_n$ and $\sum b_n$ are convergent series of nonnegative numbers, then $\sum \sqrt{a_n b_n}$ converges.
Hint: Show $\sqrt{a_n b_n} \le a_n + b_n$ for all n.

18. We have seen that it is often a lot harder to find the value of an infinite sum than to show it exists. Here are some sums that can be handled.

(a) Calculate $\sum_{n=1}^{\infty} (\frac{2}{3})^n$ and $\sum_{n=1}^{\infty} (-\frac{2}{3})^n$.
(b) Prove $\sum_{n=1}^{\infty} \frac{1}{n(n+1)} = 1$. Hint: Note that $\sum_{k=1}^{n} \frac{1}{k(k+1)} = \sum_{k=1}^{n} [\frac{1}{k} - \frac{1}{k+1}]$.
(c) Prove $\sum_{n=1}^{\infty} \frac{n-1}{2^{n+1}} = \frac{1}{2}$. Hint: Note $\frac{k-1}{2^{k+1}} = \frac{k}{2^k} - \frac{k+1}{2^{k+1}}$.
(d) Use (c) to calculate $\sum_{n=1}^{\infty} \frac{n}{2^n}$.

19. Determine which of the following series converge. Justify your answers.

(a) $\sum_{n=2}^{\infty} \frac{1}{\sqrt{n} \log n}$

(b) $\sum_{n=2}^{\infty} \frac{\log n}{n}$

(c) $\sum_{n=4}^{\infty} \frac{1}{n(\log n)(\log \log n)}$

(d) $\sum_{n=2}^{\infty} \frac{\log n}{n^2}$

20. Show $\sum_{n=2}^{\infty} \frac{1}{n(\log n)^p}$ converges if and only if $p > 1$.

UNIT-III

21. For each of the following power series, find the radius of convergence and determine the exact interval of convergence.

(a) $\sum n^2 x^n$

(b) $\sum (\frac{x}{n})^n$

(c) $\sum (\frac{2^n}{n^2}) x^n$

(d) $\sum (\frac{n^3}{3^n}) x^n$

(e) $\sum (\frac{2^n}{n!}) x^n$

(f) $\sum (\frac{1}{(n+1)^2 2^n}) x^n$

(g) $\sum (\frac{3^n}{n \cdot 4^n}) x^n$

(h) $\sum (\frac{(-1)^n}{n^2 \cdot 4^n}) x^n$

22. For $n = 0, 1, 2, 3, \ldots$, let $a_n = [\frac{4+2(-1)^n}{5}]^n$.

(a) Find $\limsup (a_n)^{1/n}$, $\liminf (a_n)^{1/n}$, $\limsup |\frac{a_{n+1}}{a_n}|$ and $\liminf |\frac{a_{n+1}}{a_n}|$.
(b) Do the series $\sum a_n$ and $\sum (-1)^n a_n$ converge? Explain briefly.

23. Let $f_n(x) = \frac{1+2\cos^2 nx}{\sqrt{n}}$. Prove carefully that (f_n) converges uniformly to 0 on $\mathbb{R}$.

24. Prove that if $f_n \to f$ uniformly on a set S, and if $g_n \to g$ uniformly on S, then $f_n + g_n \to f + g$ uniformly on S.

25. Let $f_n(x) = \frac{x^n}{n}$. Show (f_n) is uniformly convergent on $[-1, 1]$ and specify the limit function.

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HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
(AUTONOMOUS)
B.Sc. II^nd Year Mathematics
Semester – IV
Paper IV

Code: BS404

Instruction	
Theory Classes	**4 Hrs/Week**
Practical Classes	**2 Hrs/Week**
Credit for Theory	**4**
Credit for Practical	**1**
Duration of Semester Examination	**3 Hrs**
Duration of Internal Examination	**30 Min**
Semester Examination Marks	**80 Marks**
Internal Examination Marks	**15 Marks**
Assignment Marks	**05 Marks**

ALGEBRA

DSC-1D **BS:404**

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

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

Unit- I

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

Unit- II

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

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Unit- III

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

Unit- IV

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

Text Books:

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

Reference Books:

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

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(AUTONOMOUS)
B.Sc. II[nd] Year Mathematics
Semester – IV
Practical Paper- IV

Code: BS404

Instruction	2 Hrs / Week
Duration of Exam	3 Hrs
Marks for Exam	50 Marks

Algebra

Unit-I

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

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

3. Prove that the set of all 3×3 matrices with real entries of the form

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

is a group under multiplication.

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

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

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

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

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

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

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

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Unit-II

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

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

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

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

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

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

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

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

$$\begin{bmatrix} \cos x & \sin x \\ -\sin x & \cos x \end{bmatrix}$$

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

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

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

Unit-III

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

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

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

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

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

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

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

28. Find all units, zero-divisors, idempotents, and nilpotent elements in $Z_3 \oplus Z_4$.

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

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

Unit-IV

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

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

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

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

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

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

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

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

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

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

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Logic and Sets

SEC-1A BS:301

Credits: 2 Theory : 2 hours/week

Objective: Students learn some concepts in set theory and logic.

Outcome: After the completion of the course students appreciate its importance in the development of computer science.

Unit- I

Basic Connectives and truth tables - Logical equivalence : Laws of Logic - Logical Implication :

Rules Inference : The Use of Quantifiers - Quantifiers, Definitions, and proofs of Theorems.

Unit- II

Sets and Subsets - Set Operations and the Laws of Set Theory - Counting and Venn Diagrams -

A First Word on Probability - The axioms of Probability - Conditional Probability: Independence

- Discrete Random variables .

Text:

_ Ralph P Grimaldi, Discrete and Combinatorial Mathematics (5e)

References:

_ P R Halmos, Naive Set Theory

_ E Kamke , Theory of Sets

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Theory of Equations

SEC-1B BS:301

Credits: 2 Theory: 2 hours /week

Objective: Students learn the relation between roots and coefficients of a polynomial equation, Descartes's rule of signs in finding the number of positive and negative roots if any of a polynomial equation besides some other concepts.

Outcome: By using the concepts learnt the students are expected to solve some of the polynomial equations.

Unit- I

Graphic representation of a polynomial-Maxima and minima values of polynomials-Theorems relating to the real roots of equations-Existence of a root in the general equation -Imaginary roots - Theorem determining the number of roots of an equation-Equal roots-Imaginary roots enter equations in pairs-Descartes' rule of signs for positive roots- Descartes' rule of signs for negative roots.

Unit- II

Relations between the roots and coefficients-Theorem-Applications of the theorem-Depression of an equation when a relation exists between two of its roots-The cube roots of unity Symmetric functions of the roots-examples.

Text:

_ W.S. Burnside and A.W. Panton, The Theory of Equations

References:

_ C. C. Mac Duffee, Theory of Equations

_ Hall and Knight , Higher Algebra

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Transportation and Game Theory

SEC-2C

BS:401

Credits: 2
Theory: 2 hours /week

Objective: Students learn Transportation problem, assignment problem Games with mixed strategies.
Outcome: Students come to know about nice applications of Operations Research.

Unit- I

The Transportation and Assignment Problems : The Transportation Problem - A Streamlined Simplex Method for the Transportation Problem - The Assignment Problem.

Unit- II

Game Theory: The Formulation of Two-Person, Zero-Sum Games - Solving Simple Games—A Prototype Example - Games with Mixed Strategies - Graphical Solution Procedure - Solving by Linear Programming - Extensions.

Text:

- Frederick S Hillier and Gerald J Lieberman, *An Elementary Introduction to Operations Research* (9e)

References:

- Hamdy A Taha , *Operations Research :An introduction*
- Gupta and Kapur , *Operations Research*

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Number Theory

SEC-2D

BS:401

Credits: 2
Theory: 2 hours /week

Objective: Students will be exposed to some of the jewels like Fermat's theorem, Euler's theorem in the number theory.
Outcome: Student uses the knowledge acquired solving some divisor problems.

Unit- I

The Goldbach conjecture - Basic properties of congruences- Binary and Decimal Representation of Integers - Number Theoretic Functions; The Sum and Number of divisors- The Mobius Inversion Formula- The Greatest integer function.

Unit- II

Euler's generalization of Fermat's Theorem: Euler's Phi function- Euler's theorem Some Properties of the Euler's Phi function.

Text:

- David M Burton, *Elementary Number Theory* (7e)

References:

- Thomas Koshy, *Elementary Number Theory and its Applications*
- Kenneth H Rosen, *Elementary Number Theory*

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U.G. II year Semester – III- (B.Sc) CBCS

SEC-1

INTERNAL MODEL PAPER

TIME: 1/2 HOURS MAX MARKS: 10

SECTION-A

FILL IN THE BLANKS: 5 x ½ =5 marks

TEN (10) FIB ½ MARK EACH

SECTION-B

MULTIPLE CHOICE QUESTIONS 5 x ½ =5 marks

TEN (10) MCQ ½ MARK EACH

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B.Sc Mathematics IInd Year
Semester – III & IV
Internal Examination Model Paper

Time – 30Min **Total Marks: 15 Marks**

Note: Each question carriers 1/2 Mark

I Choose correct alternative: **(10 X 1/2 =5M)**

1. (a) (b) (c) (d)
2. (a) (b) (c) (d)
3. (a) (b) (c) (d)
4. (a) (b) (c) (d)
5. (a) (b) (c) (d)
6. (a) (b) (c) (d)
7. (a) (b) (c) (d)
8. (a) (b) (c) (d)
9. (a) (b) (c) (d)
10. (a) (b) (c) (d)

II. Fill in the blanks. **(10 X 1/2 =5M)**

Note: Each question carriers 1/2 Mark

11.
12.
13.
14.
15.
16.
17.
18.
19.
20.

III. Define the following: **(5 X 1=5M)**

Note: Each question carriers 1 Mark

21.
22.
23.
24.
25.

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U.G. II year Semester – III- (B.Sc) CBCS

SEC-1

Credits – 2

THEORY MODEL PAPER

TIME: 2 HOURS

MAX MARKS: 40

SECTION-A

Answer the following in short: 5 x 2=10 marks

1.

2.

SECTION-B

Answer the following essays: 2 x 15=30marks

1 (a)

OR

(b)

2 (a)

OR

(b)

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HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
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B.Sc Mathematics IInd Year

Semester – III & IV

Theory Model Question Paper

Time: 3 hrs **Max. Marks: 80**

SECTION A

Note: Short Answer Questions:

I] Attempt any Four of the following: (4 X 5 = 20 Marks)

1) A Question from unit I
2) A Question from unit I
3) A Question from unit II
4) A Question from unit II
5) A Question from unit III
6) A Question from unit III
7) A Question from unit IV
8) A Question from unit IV

SECTION B

Note: Long Answer Questions:

II] Attempt all the Questions (4 X 15 = 60 Marks)

9) (a) A Question from unit I
(OR)
(b) A Question from unit I

10) (a) A Question from unit II
(OR)
(b) A Question from unit II

11) (a) A Question from unit III
(OR)
(b) A Question from unit III

12) (a) A Question from unit IV
(OR)
(b) A Question from unit IV

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(AUTONOMOUS)
B.Sc Mathematics- Ist Year
(2017-18) & onwords
Practical Model Question Paper
semester – I & II

Time : 2 Hrs **Total Marks:25 Marks.**

Note: Each question carries 5 Marks (4 x 5 = 20 Marks)

I] Attempt the following.

Unit I

1. a)

OR

b)

Unit II

2. a)

OR

b)

Unit III

3. a)

OR

b)

Unit IV

4. a)

OR

b)

II] Record 2 Marks

III] Vivavoce 3 Marks

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B.Sc Mathematics- IInd Year

Practical Model Question Paper

Semester – III & IV

Time : 3 Hrs | **Total Marks:50 Marks.**

Note: Each question carries $7\frac{1}{2}$ Marks | **($4 \times 7\frac{1}{2}$ = 30 Marks)**

I] Attempt the following.

1 (a) A Question from unit I
(OR)
(b) A Question from unit I

2 (a) A Question from unit II
(OR)
(b) A Question from unit II

3 (a) A Question from unit III
(OR)
(b) A Question from unit III

4 (a) A Question from unit IV
(OR)
(b) A Question from unit IV

II] Record — **10 Marks**

III] Vivavoce — **10 Marks**

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Hindi Mahavidyalaya

(Autonomous)

Mathematics Department

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3	P. Jhansi Rani RBVRR Women's college Barkatpura	
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5	Dr. V. Srinivas P.G. College Saifabad, Hydrabad.	
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