

PROGRAMME PROJECT REPORT (PPR)

Name of the Programme: **MASTER OF SCIENCE IN MATHEMATICS
(M.Sc in Mathematics)**

Duration: Minimum 2 years
 Maximum 4 years

Recognition: This Programme was recognized by DEC-IGNOU and now by the UGC-DEB.

A. PROGRAMME'S MISSION, VISION & OBJECTIVES

Mission:

The Mathematics Department is a community of learners and teacher-scholars, which has as its mission to help all its students gain an appreciation of mathematics, both as a science and as a humanistic study. The study of mathematics helps provide students with a foundation for life long learning, critical thinking, and collaborative, technical problem solving in professional contexts. This Programme aims to providing opportunities for students to extend as well as deepen their knowledge and understanding of Mathematics, and also develop research capacities, leading to specialization in Mathematical education.

Mathematics is an important problem-solving and decision-making tool used in most of the advanced development in science, engineering and technology. Therefore, a significant increase of interest in mathematics has been grown among different disciplines as well as other areas of life in recent past.

The main objectives of the Mathematics course are:

- To provide higher education in mathematics by providing access to large segments of the population, in particular the disadvantaged groups such as those living in remote and rural areas, including working people, women and other adults who wish to acquire and upgrade their mathematical knowledge and/or skills.
- To acquire knowledge about the nature, concepts, methods, techniques and objectives of advanced fields of Algebra, Complex Analysis, Geometry, Numerical Analysis etc together with some historical perspective of their development.
- To develop an enhanced skill set that will put the learners at an advantage in careers as diverse as mathematics, education, computer science, engineering and finance.
- To train learners to learn in an independent manner and know how to tackle research in mathematical sciences.

B. RELEVANCE OF THE PROGRAM WITH HEI'S MISSION AND GOALS

Kuvempu University is an affiliating State University in Karnataka. Established in 1987, it is a University with a distinctive academic profile, blending in itself commitment to rural ethos and a modern spirit. It has 37 Post-Graduate departments of studies in the faculties of Arts, Science, Commerce, Education and Law. It also has 4 constituent colleges at Shankaraghatta and Shivamogga, and two outlying regional Post-Graduate Centres at Kadur and Chikkamagalur.

The Vision and Mission of the University are:

Vision: Kuvempu University shall strive to become an international centre of excellence in teaching and research to provide high quality value based education to all through various modes to meet the global challenges.

Mission:

Foster creativity in teaching, learning and research to build a knowledge base and promote quality initiative.

Provide access to education to all.

Develop human resources to meet the societal needs.

The Distance Education Programmes are a part of the University's outreach programmes for the rural masses and also to foster University-Society relationship with the motto of "**Education for All**"., to provide quality education at the doorsteps of desirous individuals who want to take up higher education, for the discontinued who could not take up formal education, housewives and employees who want to improve and enhance their knowledge. The University firmly believes that education and seeking knowledge is a **Lifelong Learning** concept.

Offering higher education through Distance Mode is an important step taken by Kuvempu University so as to help the student community in their zeal to pursue higher education at UG and PG Level. The University felt the necessity of this when a large number of students, who wanted seats for PG. Studies, could not be accommodated in our regular P.G. Programmes. The University believes that Distance Education Mode is an equally good avenue to be made available to interested students. With these view, Kuvempu University started offering courses through distance mode since 2002-2003. At present it is offering 31 Programmes (earlier called Courses) in various faculties at the U.G., P.G. and PG Diploma levels. These courses were approved by the erstwhile DEC-IGNOU, and now by the UGC-DEB.

Goals & Objectives of Distance Mode Programmes

- Reach out to larger sections of society seeking non-formal education.
- Capacity Building using the non-formal mode platform.
- Concentrate on planning & constant upgrading of facilities to meet new challenges in education through Distance Mode.
- Provide counseling & consultancy to students.

- Offer area/ region wise educational requirements.
- Skill Development and Enhancement.
- To impart quality training through interactive learning module.
- Interactive Pedagogy of teaching-learning and flexible learning environment.
- Provide supportive academic environment and effective teaching.

The main reasons for offering this program are :

- Kuvempu University has already marked a significant footprint in mathematics teaching and research by educating a large number of learners in Mathematics at post graduate as well as under graduate level.
- This course will help the Socio-economic growth of the country by supplying more qualified mathematician, which is basic need in today's competitive environment.

C. NATURE OF PROSPECTIVE TARGET GROUP OF LEARNERS:

Kuvempu University considers following diverse class of learners for Mathematics course subject to fulfilment of the criteria for admission.

- Remote/ village intending Learners
- Those who cannot attend a full-time program due to constraints.
- Working professionals
- Government officials
- Home makers
- A class having of low level of disposable income etc.

D. APPROPRIATENESS OF PROGRAMME TO BE CONDUCTED IN OPEN AND DISTANCE LEARNING MODE TO ACQUIRE SPECIFIC SKILLS AND COMPETENCE

The program will meet the learning aspiration for mathematics by providing "another chance" to those who had to discontinue their formal education or could not join regular colleges or universities owing to social, economic and other constraints.

Students completing this programme will be able to :

- Apply theoretical as well as practical knowledge in the various branches of Mathematics.
- Channelize the background knowledge to take up their higher studies in emerging areas of Mathematics.

E. INSTRUCTIONAL DESIGN:

(i) Programme Formulation:

Proposal from the concerned PG department to commence the programme was placed before Monitoring Committee of the DDE/Syndicate. Then it will be referred to the BOS

concerned for formulation and approval of the syllabus scheme pattern, time allotment for each COURSE, marks allotment, scheme of examination etc., then it was placed in the Faculty meeting and then Academic Council (the highest body) of the University for its approval. After approval by both the bodies, the programme was introduced. The academic advisory body of DDE refers the matter to the concerned subject/parent department council for preparation of study material. The concern subject faculty will coordinate with the DDE and the department council, as he/she is on the member in it. Workshops for preparing study material in SLM mode are regularly conducted (with the help of IGNOU experts).

- (ii) **Curriculum Design:** The Programme is of 2 years duration with annual examinations. The maximum period allowed is 4 years (double the duration). The Programme structure is as below.

Year	Courses	Marks		
		Term End Exams	Continuous Evaluation/IA	Total
First Year	Course 1: Algebra	80	20	100
	Course 2: Analysis-I	80	20	100
	Course 3: Analysis-II	80	20	100
	Course 4: Differential Equations	80	20	100
	Total marks	320	80	400
Second Year	Course 5: Complex Analysis	80	20	100
	Course 6: Topology	80	20	100
	Course 7: Real and Functional Analysis	80	20	100
	Course 8: Numerical Analysis	80	20	100
	Total marks	320	80	400
Total Marks - I Year & II Year		640	160	800

- (iii) **Medium of Instruction:**

The medium of instruction shall be English.

- (iv) **Detailed syllabi:** Given as Appendix-01

- (v) **Faculty and Supporting Staff Requirement**

Full time faculty and guest faculty in regular department will be involved in orientation counseling, and face to face programmes. Such programmes are scheduled during the vacation time of the regular department, which will meet the faculty availability and infrastructure need of ODL Programme. Coordinator of the programme, who is a regular faculty member and the Research and Teaching Assistant (RTA) will be in-

charge of the Programme, who will address the day to day academic and learner/student support aspects of the Programme.

Regarding supporting staff, DDE has a separate and well equipped wing/office to take care of all the administration and delivery aspects of ODL Programmes.

There is a separate DDE wing in the Office of the Registrar (Evaluation) for all the evaluation and certification aspects headed by a Deputy/Assistant Registrar.

The DDE and Evaluation wings are fully computerized and technical staff assist in all the activities.

(vi) Instructional Delivery Mechanism

Instructional delivery mechanism is through study materials prepared by the experts in the subjects concerned. Study materials (SLM) are prepared in-house by the faculty of the department and the faculty from sister universities.

The study material provided is the general guide and covers the course content in order the learner understand core content of the course concerned. Learner are advised to make use of the reference books in the list of books provided along with the syllabus.

Contact Programme: There will be a contact programme for a duration of 21 days normally. A minimum of 21 days for instruction by experienced and scholarly faculty will be arranged for each course. There shall be interaction built around lectures, discussions, individual and group activities. A test for theory in each course will be conducted for the candidates at the end of the contact/orientation programme.

Student support service: Students can interact with the Office/Faculty through e-mails and personal visits. SMS alert facility for the students regarding dissemination of information relating to conduct of PCPs/Orientation Programme and Production file submission deadlines etc. Student Support Service is provided through online mode and grievance handling mechanism is adopted with the help of supporting technical staff. All necessary and relevant information are uploaded in the dedicated website: www.kuvempuuniversitydde.org. Internal Assignments with Guidelines, previous years question COURSEs, notifications timetables and results are available from the website.

F. PROCEDURE FOR ADMISSIONS, CURRICULAM TRANSACTION AND EVALUATION:

As outlined in Section-B, Kuvempu University has a policy to provide opportunity to maximum number of eligible and desirous candidate from all sections of the Society including a class having of low-level of disposable income, rural dwellers, women unskilled men minorities etc.

(i) Eligibility for the Programme

Candidate should have a pass B.Sc (Mathematics) or any other degree as equivalent there to shall be eligible for admission to the M.Sc. in Mathematics.

All the candidates who fulfill eligibility criteria are admitted to the programme. If university decides for maximum number of candidates for Programme, admissions are made first come first basis.

(ii) Admission Process

- Notification issued by the Directorate of Distance Education (DDE) in Regional and National News COURSEs and in the official website.
- Uploading of the Application by the candidate through Online only.
- Payment of fee through online (various options like net banking etc.) or through banks/post offices using printout of the challan.
- Submission of the printout of the application by the candidate to DDE along with original documents for eligibility, date of birth etc., and along with fee paid receipt.
- Verification of applications- for fulfillment of eligibility criteria (marks cards) documents, fee paid details.
- Approval of the admission and issue of self learning material (Study Materials) to the students.

(iii) Fee Structure

Figures in rupees as prescribed for the academic year 2017-18

SN	Fee Component	First Year	Second Year
Admission Orientation/Practical's and Other Components			
1	Registration	2160	-
2	Admission	840	840
3	Orientation/ Tuition fee	1680	1680
4	Study materials	2460	2460
5	Liaison	120	120
6	IA Books/Practical Books	420	420
7	Postage	360	360
8	UDF (DDE)	250	-
Examination , Certification and Other Components			
9	Examination	1210	1210
10	PPC	-	365
11	Convocation	-	900
12	UDF (Exams)	120	120
TOTAL (Rupees)		9,620	8,475

Financial Assistance:

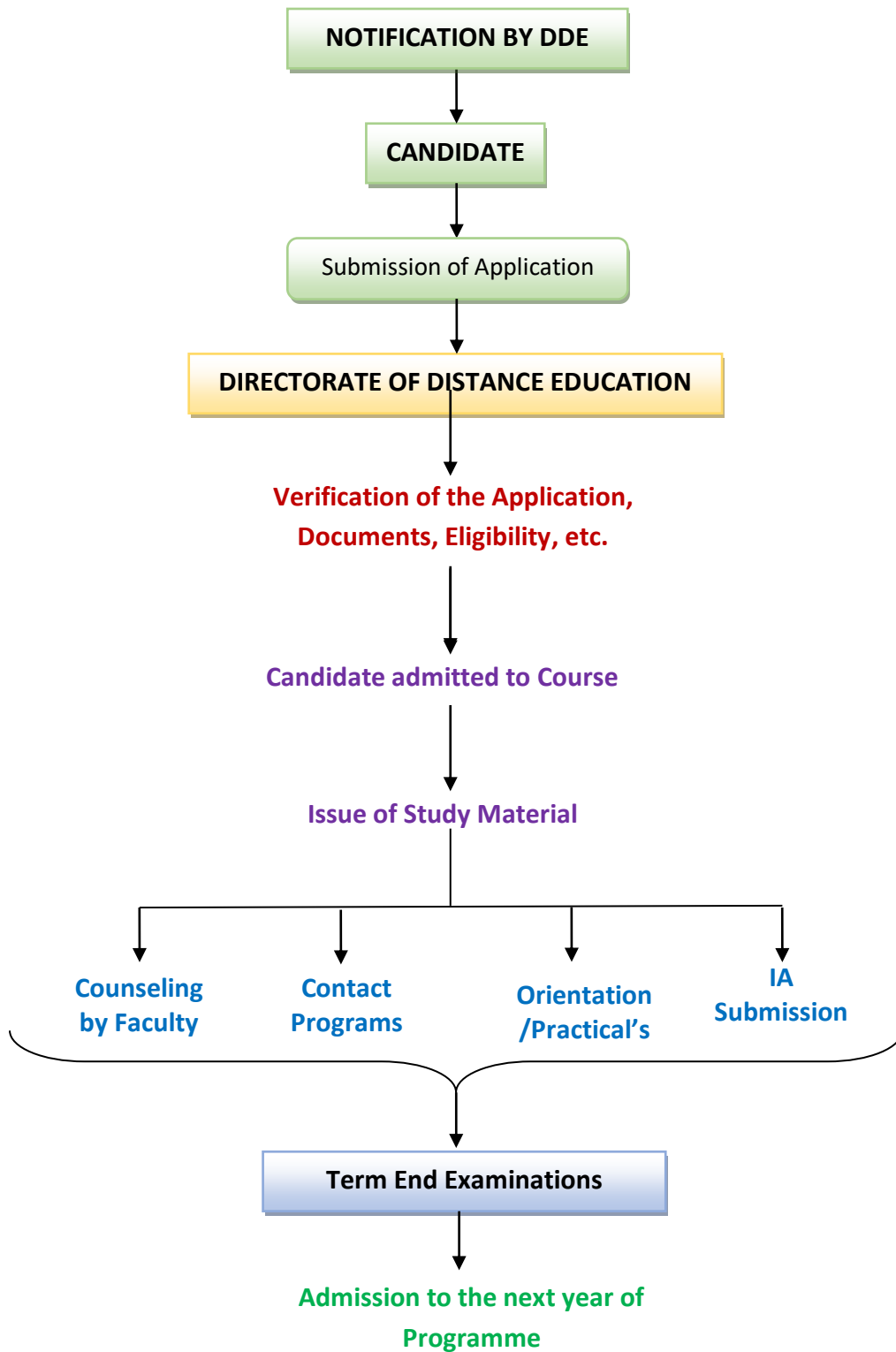
- SC/ST and OBC Students can avail scholarship/fee reimbursement from the concerned State Departments/Agencies
- Fee Concession to Physically Handicapped Candidates.
- Fee concession to Employees of the University and their dependents.
- Fee concession to Ex- servicemen.

Scholarships and education supports extended by various Governmental and Non-Governmental agencies.

Academic and Activity Planner

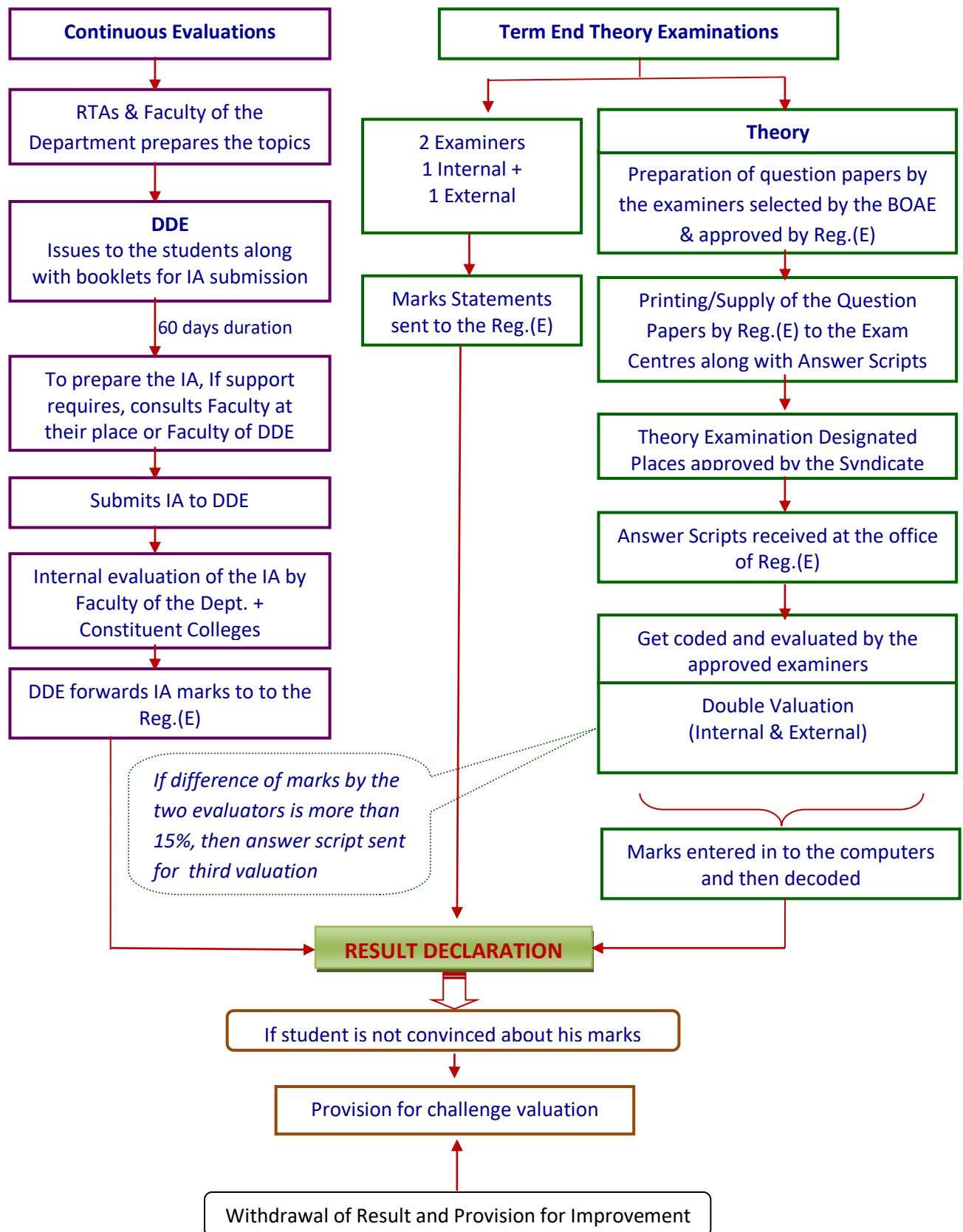
Calendar Year-I		
1	Issue of Notification	July / August
2	Commencement of Online Admissions	July / August
3	Last Date for submission of online applications by the students without Late Fee	October 31
4	Last Date for submission of online applications by the students with late fee	December 31
5	Issue of Study Material and Assignment Books (immediately after verification of the applications)	July to December
Calendar Year-II		
6	Issue of assignment topics Commencement of Counseling sessions	December - January
7	Commencement of Face-to-Face (Orientation) Sessions	February –March
8	Completion of all Orientation Sessions	April 30
9	Last date for Submission of Internal Assignments/ Project Reports	April 30
10	Tentative date for commencement of Examination.	May / June
11	Declaration of Examination Results	August / September

Generalised Academic Flow Chart for the Distance Mode Learners



(iv) Evaluation of Learner Progress

Evaluation Process is given here in the form of Flowchart. This Flowchart is common to all Programme at UG, PG and PG Diploma level offered by the University.



Internal Assessments:

- As a part of continuous assessment the candidates will have to complete assignments in the booklets provided by DDE and submit them to the Directorate of Distance Education within the specified date. The Topics & Instructions for I.A. will be notified in the Students Corner section of the website and also issued to the students directly or through Student Counseling Centres.
- It is mandatory to submit the I.A. in the same year of registration. However, if the candidate failed to take up the theory examination, for any reason, such candidate can submit the I.A. in the next year with prior permission from the DDE.
- All students are expected to complete the above assessments before taking the Term end Examination.
- There is no provision for resubmission of I.A.

Provision for class tests and workout exercises: during Counseling and Face-to-Face (Orientation/Contact) programmes.

(v) Term End (written) Examination:

Duration: Duration: 3 hours, **Maximum marks:** 80

Theory Questions pattern

Section	Type of Questions	Marks	Total
A	Five long answer type	14x5	70
B	One long answer type	10x1	10
Total			80

Declaration of class: At the completion of course evaluation (the Programme) the class will be awarded on the basis of the aggregate of marks at both previous and final examinations taken together.

Pass Class : 40% of marks or above but below 50% of marks.
Second class : 50% of marks or above but below 60% of marks.
First Class : 60% of marks or above.

Separate Ranks and Medals are awarded to ODL Learners. Policy for awarding ranks and medals are same as the one followed for the Regular Programme.

Reappearing for Exams: The unsuccessful candidates at the P.G. Examinations of a particular year are required to reappear for those COURSES/examinations only as per the syllabus of that year. The repeaters are therefore advised to preserve the syllabus and study material until they pass the final year of the course.

Candidates will have to complete all the exams within double the durations of the course (and not the number of attempts). The double the duration is reckoned from the year of registration.

A candidate is permitted to register for the final year examination irrespective of the number of courses failed at the previous theory exams.

(vi) Other Policy/Provisions

Renewal of Registration: Students of II year who have failed to pay the II year programme fee in the respective year are permitted to renew their registration by paying the specified course fee along with registration renewal fee and continue their programme. However they should complete the programme within the maximum permissible period i.e., 4 years.

Bonafide student certificate: Those candidates who require Bonafide Certificate/ Study Certificate can obtain by submitting a written request or a filled in prescribed application form (available from the KUDDE website) along with a fee of Rs. 100/- paid either through Bank Challan or Demand Draft.

Change of Address: Any change in the address of the students should be intimated to the Directorate with a fee of Rs. 100/- paid through a challan of Electronic Transfer. No change of address will be entertained once the students receive their examination hall ticket. The Directorate of Distance Education is not responsible for missing correspondence due to change of address without getting address changed at DDE.

Name Correction: Change of Name, if any required, candidate has to make a written request along with relevant documents as proof of change of name, and by paying specified fee.

Duplicate Registration Card: For issue of duplicate Admission/Registration/ Enrollment card- Rs. 200/- will be charged.

Transfer Certificate: A Transfer Certificate is not required for admission to any of the KUDDE courses. The Directorate will also not issue Transfer Certificate at the time of completion of the course. However, for Lateral Entry admissions a migration and transfer certificate will be required from such students.

Change of Examination Centre: DDE will not entertain any change of exam centre unless there is a proof of change of address and it is permissible.

Discrepancies in Marks cards and certificates: In case of any discrepancies observed in the marks card/ certificates etc., candidates have to bring it to the notice of the Director, DDE through a written request within a period of 3 months from the date of issue of the document.

Miscellaneous: All the original certificates submitted by the candidates in connection with their admission, registration will be returned to them from the Office of the DDE along with the registration certificate. In case any of their certificates are not received back, they must bring the same to the notice of The Director, DDE, Kuvempu University, immediately. The original records will be maintained for a minimum period of three months. If the candidates ask for the originals before three months, their requests will not be entertained.

Preservation of Answer Scripts / IA Scripts: The answer scripts of Theory Exams will be preserved for a maximum duration of 6 months from the date of announcement of results/ revaluation / challenge valuation results. Any query or request for verifications may be submitted, through a written request, within the notified period only.

Similarly, written IA Scripts of the students will be preserved for a period of six months from the date of announcement of the results (First announcement of results). Any discrepancy observed regarding IA marks may be informed to DDE through a written request within three months from the date of issue of results. Later request may not be accepted.

Students are advised to refer the website for notifications regarding preservation of various documents, issued from time to time.

Notwithstanding any conditions mentioned above the University reserves the right to change, alter, and amend any of the above clauses/conditions. In matters of fees for unforeseen issues / certificates/ endorsements the University may fix the amount subject to the existing fee structure or change it from time to time.

Post-Examination Related Issues: For all matters regarding post-examination Certifications - such as, issue of Convocation (Degree) Certificates, Duplicate Marks Cards, Provisional Pass Certificate (PPC), Name Correction, Consolidated Marks Cards, removal of NCL, Academic Transcript, verification of genuineness of Marks Cards and Certificates, and Processing Certificates - enquiries can be made directly at the Office of Registrar (Evaluation). Candidates are informed to contact, for any related information/clarifications, the Helpdesk at the O/o Registrar (Evaluation) by telephone and e-mail ID given the website.

G. REQUIREMENT OF LABORATORY SUPPORT & LIBRARY RESOURCES

The Kuvempu University has well established laboratory space to meet the curriculum requirements of the programs.

A well established library facility shall be made available with the support of the university library. In the campus we have modern and well equipped building of library in Kuvempu University offers excellent infrastructure facilities in reading, browsing and reference to the students, teachers and research scholars. The library has kept pace with modernization by introducing CD ROM data base, internet and e-mail facilities. It is also a nodal centre for INFLIBNET, access is available to 10,000 + e-journals online under the UGC- infonet Consortia. There is a well developed digital library and campus network interconnecting all the Post-Graduate departments and offices in the campus.

Further, the DDE will made special effort to upgrade the existing DDE Library exclusively for distance learners with an emphasis on distribution of information and course material online by making use of the state-of-art information and communication technologies.

Library Card: Candidates who are desirous to avail themselves the facilities of Kuvempu University Main Library on the campus will be permitted. They have

to obtain a separate Library / ID Card on payment of Rs. 100/- (through Challan of Electronic Transfer). However, no books will be issued to them.

H. COST ESTIMATE OF THE PROGRAMME AND THE PROVISIONS

Cost Estimated of the Programme is based on following components

– calculated for an admission of 100 Students:

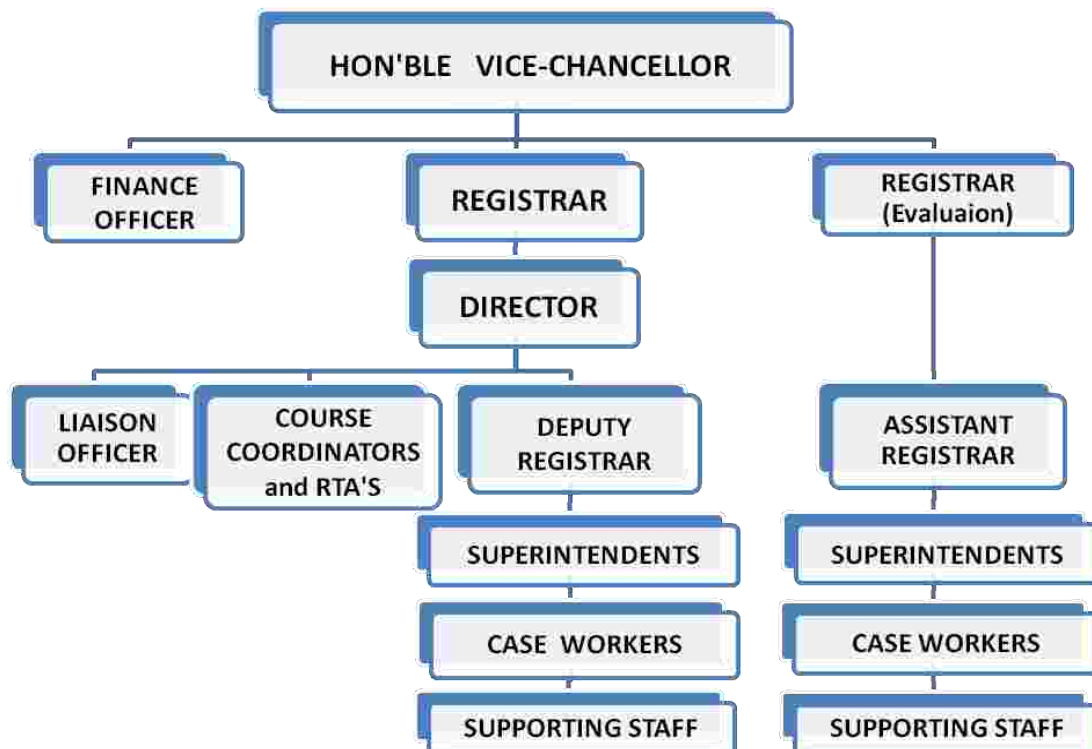
SN	Component	Estimate in Lakh Rupees
1	Study Material Development – Course Writer honorarium, Review vetting, editing, SLM conversion etc	4.92
2	Printing and Distribution of SLM	2.95
3	Publicity, Awareness Information Decimation Programmes*	0.14
4	Conduction of Counselling, Orientation/Face to Face, etc.	2.52
5	Student Support Services*	0.42
6	TA/DA Meeting Expenses*	0.22
7	Continuous Evaluation / IA	0.25
8	Examination and Certification	2.58
9	Office Automation/ICT/ Communication Related Infrastructure*	0.43
10	Library*	0.25
11	Staff Salaries/ Remunerations/ Other Honorariums – Teaching, Non-Teaching/Technical/Supporting*	1.34
12	Office Infrastructure*	0.34
13	Learner Centre Expenses*	0.31
14	Others – Office Contingence, Post/Courier, Vehicle Maintenance, Fee reimbursement and such others.*	0.58

Note: * costs that will be incurred collectively for all the Programmes, but given here are the fractions of the total, considering 100 students admission to the Programme.

I. QUALITY ASSURANCE MECHANISM AND EXPECTED PROGRAMME OUTCOMES

(a) Organizational Structure, Management and Monitoring Mechanism

The Organizational Structure of the Kuvempu University Directorate of Distance Education (KUDDE) is given below in the form of flowchart.



For the administrative and policy decisions, and reviewing and monitoring of the ODL activities, Kuvempu University has a Monitoring Committee (MC) Chaired by the Honorable Vice-Chancellor. The Registrar, Registrar (Evaluation), Finance Officer, Deans of all the Faculties, Chief Librarian, One Syndicate Member, One Academic Council Member and the Regional Director of the IGNOU, are its members. The Director, DDE is the Organising Member. The operational plans, goals and policies are decided by the MC, and all the decisions and policy matters are placed before the Monitoring Committee before implementation. The Committee normally meets twice a year to review the ODL Programmes and activities.

Academic Advisory Committee (AAC) of the DDE will review the academic programme performance, content delivery mechanism. Issues regarding course content and syllabi revision of all the Programme offered in ODL mode are discussed and decided in AAC. The Registrar will be the Chairman of the AAC, and Registrar (Evaluation), Chairpersons of all BOSs of the concerned Departments will be the members. The Director/ Deputy Director of the DDE is the Organising Member.

All the major decisions including financial, planning and implementation which are discussed in the MC meeting are placed before the Syndicate of the University and after its approval they will come into force.

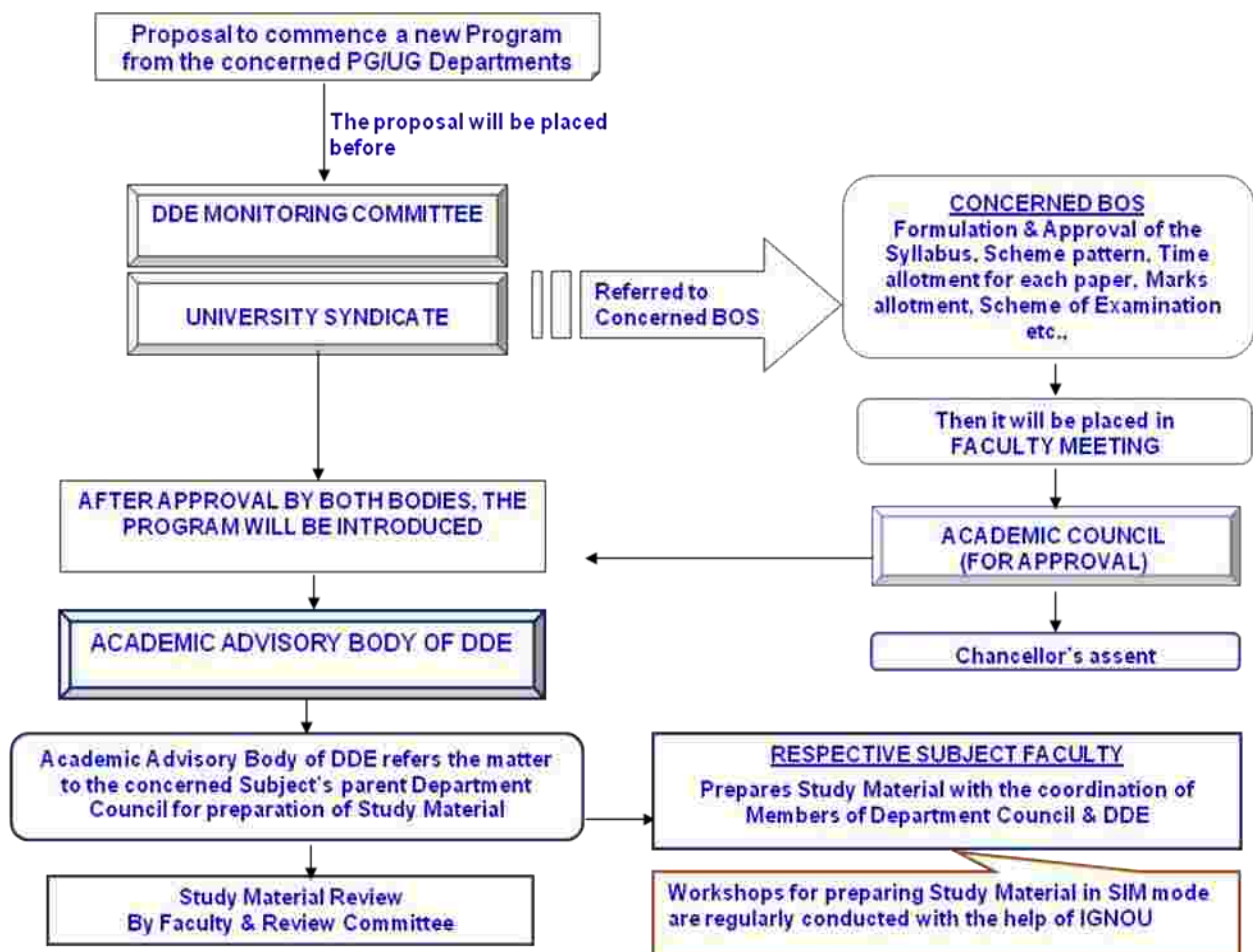
The decisions taken by the AAC are placed through the concerned bodies like, BOS/ Examination wing (for evaluation and certification issues) and finally placed before the Academic Council of the University for its approval.

For the internal quality assurance mechanism there is a Internal Quality Assurance Cell of the University.

(a) Programme Development and Approval Processes.

Proposal from the concerned PG/ UG department to commence a new Programme will be placed before Monitoring Committee of the DDE/ Syndicate. Then it will be referred to the BOS concerned for formulation and approval of the syllabus, programme structure, time allotment for each COURSE, marks allotment, scheme of examination etc., then it will be placed in the Faculty meeting and then Academic Council for its approval. After approval by both the bodies, the programme will be introduced. The Academic Advisory Body of DDE refers the matter to the concerned Subject’s/ parent Department Council for preparation of Study Material. The concern subject Faculty will coordinate with the DDE and the Department Council, as he/ she is one of the member in it. Workshops for preparing Study Material in SLM mode are regularly conducted (with the help of IGNOU experts) and preparation of course material in SLM mode is in progress.

The various steps involved in programme development, approval and implementation are depicted in the flowchart given below.



(b) Programme Monitoring and Review

As a part of the regular monitoring mechanism, feedback from the Learners is obtained at the end of each of the face-to-face programmes - both through discussion and through

written feedback form. Feedback form includes mainly three aspects – about appropriateness/ usefulness of learning (study) materials, effectiveness of orientation/ face-to-face programmes and internal assessments/continuous assessment process. Learner can give their opinion, suggestions and complaints, if any, through the feedback form. Issues raised in feedback are addressed at appropriate level.

There is also Student Support Service and Grievance Cell in DDE in order to address the day-to-day issues faced by the Learners. The Research and Teaching Assistants at DDE and the Coordinator in the concerned the subjects are available for the learner support services. These apart, regular meetings of concerned faculty are conducted in order to plan the orientation and practical session's activity.

It is the policy of the KUDDE to make available the expert faculty of the PG Departments/ Colleges (for UG) and experts from the sister universities in the state who are regular faculty in the respective subjects for the ODL programmes. The same is followed for the Learner Support Centres (LSC). Programme delivery/academic activities at the LSC are also monitored from the Headquarter.

DDE is organizing Coordinators Meet every year wherein all the issues related to ODL programmes – academic, examination, learners related and administration are discussed and remedial measures are considered under the ODL framework of the university. During the Meet academic activities/learners' issues at the LSC are also reviewed.

Detailed Syllabi of M.Sc. in Mathematics Programme

FIRST YEAR

COURSE – I : ALGEBRA CODE : PM- 10.01

A Review of Preliminaries on Groups, Rings, Vector spaces and Fields.

Unit 1: Permutation groups: Sylow's theorems, Solvable groups; Direct products of groups and structure of finite Abelian groups.

Unit2: Rings; Prime and Maximal ideals; Euclidean and Principal ideal rings; Unique factorization domains, Polynomial rings.

Unit 3:Vector spaces; Minimal polynomials; Nilpotent transformation, Canonical forms; Inner product spaces, Finite dimensional spectral theory; Quadratic forms – Sylvester's law of inertia; Criterion for positive definiteness

Unit 4:Fields: Extension fields; Prime fields; Algebraic and transcendental extensions; Roots of polynomials; Splitting fields; Finite fields; Separable and inseparable extensions; Perfect and imperfect fields; Simple extensions; Galois theory; Solvability of polynomials by radicals; Abel's theorem.

Reference:

1. Topics in Algebra : I.N.HERSTEIN
2. A First Course in Abstract Algebra : J.B.FRALEIGH
3. Finite Dimensional Vector Spaces : P.R.HALMOS
4. Modern Algebra : SURJEET SING & QAZI ZAMEERUDDIN
5. Linear Algebra : HOFFMAN & KUNZE

COURSE – II : ANALYSIS – I CODE : PM- 10.02

Unit 1:Dedekind's construction of the real number system. The extended real number system. Complex numbers. Euclidean space $R(n)$. The binomial inequality. The inequality of the Arithmetic and Geometric means. The inequality of the power means. Cauchy's, Holder's and Minkowski's inequalities.

Unit 2:Numerical sequences and series of real and complex terms. Convergent sequences, Cauchy's sequences, Upper and Lower limits. Multiplication of series, Riemann's rearrangement theorem.

Unit 3: The Topology of the real line, continuity, Uniform continuity. Properties of continuous functions, Discontinuities. Monotonic functions. Differentiability, Mean Value theorems. L' hospital rule. Taylor's Theorem. Maxima and Minima. The Riemann – Stieltje's integral. Criterion for integrability. Properties of the integral. Classes of integrable functions. The integral as a limit of a sum. First and Second mean value theorems. Integration and differentiation. Functions of bounded variation.

Reference:

1. Principles of Mathematical Analysis : W.RUDIN
2. Mathematics Analysis : T.M.APOSTAL
3. Methods of Real Analysis : R.R.GOLDBERG
4. Advanced Calculus : D.V.WIDDER

COURSE – III : ANALYSIS – II CODE : PM- 10.03

Unit 1: Multiplication of series, rearrangements. Double series, Infinite products. Sequences and series of functions. Uniform convergence. Uniform convergence and continuity. Uniform convergence and integration. Uniform convergence and differentiation. Power series. The exponential and logarithmic functions. The trigonometric functions.

Unit 2: Improper integrals. Tests of convergence. The Beta and Gamma functions. Improper integrals with integrand containing a parameter – their uniform convergence, continuity, integrability and differentiability with respect to a parameter. Functions of several variables, partial derivatives, continuity and differentiability. Chain rule. Euler's theorem on homogeneous functions. Jacobians. Implicit function theorem. Taylor's theorem. Maxima and Minima. Lagrange's Multipliers. Multiple integrals (forms) treatment. Applications.

References:

1. Principles of Mathematical Analysis : W.RUDIN
2. Mathematical Analysis : T.M.APOSTAL
3. Methods of Real Analysis : R.R.GOLDBERG
4. A course in Mathematical Analysis : S.SHANTINARAYAN

COURSE-IV : DIFFERENTIAL EQUATIONS CODE : PM- 10.04

Unit 1: Preliminaries on First order Ordinary Differential Equations; Exact equations and integrating factors.

Unit 2: Linear equations of Second order; Homogeneous equations and general solutions; Green's functions; Variation of parameters, Initial value problems, Wronskian, Boundary value problems; Sturm Liouville theory; Oscillation theorems.

Unit 3: Homogeneous equation of order n. Initial value problems, Non-homogeneous equations.

Unit 4: Solution by series; Regular and Singular points; Special functions; Legendre equation, Hypergeometric series; Bessel functions.

Unit 5: Integral transforms; Fourier theorem; Laplace and Fourier transforms.

Unit 6: Existence and Uniqueness theorems, First order systems; Existence of solution to n^{th} order equation.

Unit 7: First order partial differential equations; Linear, Semi-linear, Quasi-linear, General nonlinear first order equations; Cauchy problem in each case. Second order equations. Laplace, wave and Heat equations.

Reference:

1. An Introduction to Ordinary Differential Equations : E.A.CODDINGTON
2. Ordinary Differential Equations : BIRKOFF & ROTA
3. Elements of Partial Differential Equations : I.N.SNEDDON
4. Partial Differential Equations : PHOOLAN PRASAD & RENUKA RAVINDRAN

SECOND YEAR

COURSE-V: COMPLEX ANALYSIS CODE : PM - 10.05

Unit 1:**Algebra of Complex Numbers:** Geometric representation, Theory of power series – sequences, Series, Uniform convergence, Abel’s Limit theorem; elementary functions; Topology of the complex plane; Linear transformations; Elementary conformal mappings.

Unit 2: Complex Integration; Cauchy’s theorem; Cauchy’s integral formula; Local properties of analytic functions; Taylor and Laurent series expansions; Calculus of residues.

Unit 3: Harmonic Functions- Definition and basic properties; Mean value property; Poisson’s formula for a disk; Schwartz theorem.

Unit 4: Mittag - Leffler’s theorem; canonical products; Weierstrass theorem; Gamma function; Jensen’s formula.

Reference:

1. Complex Analysis : L.V. AHLFORS
2. Functions of one Complex Variable : J.B.CONWAY
3. Real and Complex Analysis : WALTER RUDIN

COURSE – VI : TOPOLOGY CODE : PM - 10.06

Unit 1: Basic set theory, Topological Spaces; Open sets and closed sets; Interior, Closure, exterior and boundary; relative topology; Bases and sub-bases; Separability and Countability axioms; Convergence and continuity; Product topology, Box and Uniform topologies; Weak topologies; Quotient topology.

Unit 2: Connectedness; Basic properties of connected spaces, path connected spaces; Various counter examples, Components and path components; Locally connected and Locally path connected spaces.

Unit 3:Compactness: Covering properties, Lindelof spaces, Basic properties of compact spaces; Countable compactness; Sequential compactness; Bolzano Weierstrass property, Compactness in metric spaces; Tychonoff’s theorem.

Unit 4:Separation axioms; Hausdorff, Regular, Normal and completely regular spaces; Complete and collection wise normal spaces; Uryshon’s Lemma; Tietze’s extension theorem, Local compactness and one point compactification; Stone-Cech compactification.

Unit 5:Embedding and metrization: Uryshon’s metrization theorem; Nagata Smirnov-Bing metrization theorem; Paracompact spaces; Partition of Unity.

Reference:

1. A First Course in Topology : J.R.MUNKRESS
2. General Topology : J.L.KELLY
3. General Topology : S.WILLARD
4. Topology : J.DUGUNDJI

COURSE – VII : REAL & FUNCTIONAL ANALYSIS CODE : PM - 10.07

REAL ANALYSIS:

Unit 1: Lebesgue measure – outer measure, Measurable sets and Lebesgue measure, a nonmeasurable set, measurable functions, the Lebesgue integral are Lebesgue integral of a bounded function over a set of finite measure, the integral of a non-negative function, the general Lebesgue integral. Differentiation and integration – differentiation of monotonic functions, Functions of bounded variation, differentiation of an integral, absolute continuity. The classical Branch spaces the L_p -spaces. The Holder and Minkowski inequalities, Convergence and completeness, Bounded linear functionals on the L_p -spaces.

FUNCTIONAL ANALYSIS:

Unit 2: Equivalence of Compactness, Sequential compactness and completeness plus total boundedness for a metric space. Metric completion. Banach's contraction mapping theorem and applications. Baire category theorem. Ascoli-Arzelà theorem. Picard's theorem on the existence and Uniqueness of solutions of an ordinary differential equation of the first order. Linear spaces and Linear operators. Norm of a bounded operator. The Hahn-Banach extension theorems. Stone Weierstrass theorem.

Reference:

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|---|--------------------------------------|
| 1. Real Analysis | : H.L.ROYDEN |
| 2. Measure & Integration | : DE BARRA |
| 3. Introduction to Topology & Modern Analysis | : G.F.SIMMONS |
| 4. First Course in Functional Analysis | : CASPER COFFMAN &
GEORGE PEDRICK |

COURSE VIII : NUMERICAL ANALYSIS CODE : PM - 10.08

Aim of Numerical Analysis; Error Analysis, Propagation of Errors

Unit 1: Theory of iterative methods; Fixed point theorem in metric spaces; Orders of convergence; Approximate methods for nonlinear equations. Solution of algebraic & transcendental equations; Newton_Raphson method; Secant method, Aitken's method, Lehmer-Schur's method for locating zero's Polynomials, Bairstow's method.

Unit 2: Solutions of linear system of equations; Gauss pivotal methods; Gauss-Jordan method Gradient and conjugate gradient methods, Jacobi & Gauss-Seidel methods; Over relaxation methods. Error bounds in Gauss elimination.

Unit 3: Interpolation theory, Polynomial interpolation Lagrange, Aitken and Hermite interpolations, Uniform interpolation, Inverse interpolation, Least Square approximation, Curve fitting.

Unit 4: Numerical differentiation and quadrature; Newton_Cotes integration formulas; Richardson's extrapolation; Gaussian quadrature; Gauss-Legendre & Gauss-Chebyshev formulae Romberg integration.

Unit 5: Spline approximation, Cubic splines; Existence, Uniqueness, Best approximation property, Application to interpolation, Differentiation, Integration and Curve fitting.

Unit 6: Eigen value problem; Householder transformations, Heisenberg form, Power method; Inverse power method, Rayleigh Quotient method, Jacobi type methods, QR algorithms.

Unit 7: Numerical solution of ordinary differential equations; Runge Kutta-Gill methods; Predictor – Corrector method, Quasilinearization methods. Solution of boundary value problems by method of undetermined co-efficients, Finite difference methods.

Unit 8: Numerical Solutions of Partial Differential Equations; Finite difference methods, Stability Analysis.

Reference:

1. A First Course in Numerical Analysis : A. RALSTON
2. An Introduction to Numerical Analysis
for Engineers and Scientists : R.K.JAIN, S.R.K.IYENGAR & M.K.JAIN
3. Elements of Numerical Analysis : S.S.SASTRY