

Ph.D. MATHEMATICS

Curriculum and Syllabus
Regular (2024-2025)



DEPARTMENT OF MATHEMATICS
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established under section 3 of UGC Act, 1956)

(Accredited with A+ Grade by NAAC in the Second Cycle)

Pollachi Main Road, Eachanari (Post), Coimbatore- 641021, Tamil Nadu, India

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Regulations
for
Ph.D., Full Time (FT) / Part Time (PT)

As per the UGC (Minimum Standards and Procedures for Award of Ph.D., Degree)
Regulations, 2022

The Regulation will be effective from 7th November, 2022
(The research scholars admitted from January, 2023 onwards will be governed by this regulation)



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Regulations for Ph.D., Full Time (FT) / Part Time (PT)

1.0 Preamble

The Degree of Doctor of Philosophy (Ph.D.,) is awarded to a candidate who has submitted a thesis on the basis of original and independent research work done in any particular discipline or involving more than one discipline (inter-disciplinary), that make a contribution to the advancement of knowledge, which is approved by Board of Examiners as per the requirement.

2.0 Eligibility Criteria for admission to the Ph.D., Programme:

- 2.1 A 1-year/2-semester master's degree programme after a 4-year/8-semester bachelor's degree programme or a 2-year/4-semester master's degree programme after a 3-year bachelor's degree programme or qualifications declared equivalent to the master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade in a point scale wherever grading system is followed

or equivalent qualification from a foreign educational institution accredited by an assessment and accreditation agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of the educational institution.

- 2.2 Candidate seeking admission after a 4-year/8-semester bachelor's degree programme should have a minimum of 75% marks in aggregate or its equivalent grade on a point scale wherever the grading system is followed. A relaxation of 5% marks or its equivalent grade may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per the decision of the Commission from time to time.

Candidates who have completed the M.Phil. programme with at least 55% marks in aggregate or its equivalent grade in a point scale wherever grading system is followed or equivalent qualification from a foreign educational institution accredited by an assessment and accreditation agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of educational institutions, shall be eligible for admission to the Ph.D. programme. A relaxation of 5% marks or its equivalent grade may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per the decision of the Commission from time to time

- 2.3 The Part Time research scholars have to report to the guide once in a month till they submit their Synopsis/Thesis.

3.0 Admission

Admission for Ph.D. programme shall be made on half yearly basis viz. January and July. The admission shall be based on the criteria notified by the Institution, keeping in view the guidelines/norms issued by the UGC and other statutory bodies concerned and taking into account the reservation policy of the Central / State Government and the number of vacancies available with each recognized guide of the Department concerned.

4.0 Selection Procedure

4.1 The candidates will be selected for admission to Ph.D., programme based on the performance in the **Entrance Test** and **Interview** conducted to assess the aptitude of the candidate for research, subject to satisfying the eligibility conditions.

The candidates who have qualify for fellowship/scholarship in UGC-NET//UGC-CSIRNET/GATE/CEED and similar National level tests based on an interview. And/or The candidates who have qualified from “Karpagam Academy of Higher Education entrance test” conducted at the level of our Institution. The Entrance Test syllabus shall consist of 50% of research methodology, and 50% shall be subject-specific.

Students who have secured 50% marks in the entrance test are eligible to be called for the interview. A relaxation of 5 % marks will be allowed in the entrance examination for the candidates belonging to SC/ST/OBC/differently-abled category, Economically Weaker Section (EWS), and other categories of candidates as per the decision of the Commission from time to time.

KAHE may decide the number of eligible students to be called for an interview based on the number of Ph.D. seats available.

- 4.2 The candidates selected for admission to the Ph.D., programme shall be required to submit attested copy of the certificates with 3 passport size recent Photo. The original certificates brought during interview will be returned immediately after verification.
- 4.3 Provided that for selection of candidates, a weightage of 70% to the entrance test and 30% to the performance in the interview shall be given.
- 4.4 The Karpagam Academy of Higher Education shall maintain the list of all the Ph.D., registered students on its website year-wise. The list shall include the name of the registered candidate, topic of his/her research, name of his/her supervisor / co-supervisor and date of enrolment /registration.
- 4.5 Admission of International students in Ph.D., programme is also based on Entrance test and Interview keeping in view the guidelines/norms in this regard issued by statutory/regulatory bodies concerned from time to time.

5.0 Eligible Degrees for Ph.D., Registration:

Master's degree / M.Phil., Degree in the relevant disciplines or 4-Year Bachelor's Degree in the relevant disciplines, approved by Central and State approval authority.

6.0 Duration of the Programme

Ph.D. Programme shall be for a minimum duration of three (3) years, including coursework, and a maximum duration of six (6) years from the date of admission to the Ph.D. programme.

A maximum of an additional two (2) years can be given through a process of re-registration as per the Statute/Ordinance of the Higher Educational Institution concerned; provided, however, that the total period for completion of a Ph.D. programme should not exceed eight (8) years from the date of admission in the Ph.D. programme.

Provided further that, female Ph.D. scholars and Persons with Disabilities (having more than 40% disability) may be allowed an additional relaxation of two (2) years; however, the total period for completion of a Ph.D. programme in such cases should not exceed ten (10) years from the date of admission in the Ph.D. programme.

Female Ph.D. Scholars may be provided Maternity Leave/Child Care Leave for up to 240 days in the entire duration of the Ph.D. programme.

Ph.D. programmes through part-time mode will be permitted, provided all the conditions stipulated in these Regulations are fulfilled.

The Higher Educational Institution concerned shall obtain a “No Objection Certificate” through the candidate for a part-time Ph.D. programme from the appropriate authority in the organization where the candidate is employed, clearly stating that:

- i. The candidate is permitted to pursue studies on a part-time basis.
- ii. His/her official duties permit him/her to devote sufficient time for research.
- iii. If required, he/she will be relieved from the duty to complete the course work.

7.0 Conversion from Full Time Ph.D. to Part Time Ph.D. and Vice-versa

- i. Conversion from Full time to Part time or vice versa is permitted on recommendation of the Research Supervisor
- ii. A conversion fee of ₹2000 has to be paid towards the conversion.

8.0 Modification of Topic

Modification of topic of research by the candidate is permitted. A fee of ₹ 2000 has to be paid for a change of topic of research. The time limit fixed for modification of topic of research in Ph.D., programme is up to final DCM prior to submission of synopsis.

9.0 Language

The Ph.D., Part I course work and Part II synopsis / thesis must be written in English for subjects other than languages.

10.0 Eligibility criteria to be a Research Supervisor:

Permanent faculty members working as Professor/Associate Professor with a Ph.D., and at least five research publications in peer-reviewed or refereed journals and permanent faculty members working as Assistant Professors with a Ph.D., and at least three research publications in peer-reviewed or refereed journals may be recognized as a Research Supervisor in the university where the faculty member is employed. Such recognized

research supervisors cannot supervise research scholars in other institutions, where they can only act as co-supervisors. Ph.D. awarded by a university under the supervision of a faculty member who is not an employee of the university would be in violation of these Regulations.

For Ph.D. scholars working in Central government/ State government research institutions whose degrees are given by Higher Educational Institutions, the scientists in such research institutions who are equivalent to Professor/Associate Professor/Assistant Professor can be recognized as supervisors if they fulfill the above requirements.

Provided that in areas/disciplines where there is no, or only a limited number of peer-reviewed or refereed journals, the Higher Educational Institution may relax the above condition for recognition of a person as Research Supervisor with reasons recorded in writing.

Adjunct Faculty members shall not act as Research Supervisors and can only act as co-supervisors.

However, Co-Supervisor can be allowed in inter-disciplinary areas from other departments of the same institute or from other institutions with the approval of the Doctoral Committee.

In case of interdisciplinary/multidisciplinary research work, if required, a Co-Supervisor from outside the University may be appointed.

A Research Supervisor who is a Professor, at any given point of time, can guide a maximum of 8 Ph.D., scholars only. An Associate Professor upto a maximum of 6 Ph.D., scholars and an Assistant Professor upto a maximum of 4 Ph.D., scholars.

In case of relocation of a female Ph.D. scholar due to marriage or otherwise, the research data shall be allowed to be transferred to the Higher Educational Institution to which the scholar intends to relocate, provided all the other conditions in these Regulations are followed, and the research work does not pertain to a project sanctioned to the parent Institution/Supervisor by any funding agency. Such scholar shall, however, give due credit to the parent institution and the supervisor for the part of research already undertaken.

Faculty members with less than three years of service before superannuation shall not be allowed to take new research scholars under their supervision. However, such faculty members can continue to supervise Ph.D. Research scholars who are already registered until superannuation and as a co-supervisor after superannuation, but not after attaining the age of 70 years.

11.0 Admission of International students in Ph.D., programme.

Each supervisor can guide up to two international research scholars on a supernumerary basis over and above the permitted number of Ph.D. scholars as specified.

12.0 Change of Research Supervisor

Transfer of Ph.D., scholars from one Research supervisor to another Research supervisor shall be permitted under the following conditions:

- i. If the Research Supervisor resigns and leaves the institution.
- ii. If the Research Supervisor expresses unwillingness to guide the candidate
- iii. If the Research Scholar expresses his/her unwillingness to work under a specific Research Supervisor.

- iv. By mutual consent.
- v. A fee of ₹2000 has to be paid towards the change of Research Supervisor, if the change is requested by the Research scholar.

13.0 Doctoral Committee (Research Advisory Committee as per UGC)

There shall be a Doctoral Committee (Research Advisory Committee as per UGC) for every Ph.D., scholar to monitor the progress of his/her research work. The Research Supervisors in consultation with Head of the Department shall furnish a panel of minimum five experts with doctoral qualification in their respective research field, from the other Academic Institutions / National Laboratories and established research laboratories. From this list one will be nominated as a external expert for each Ph.D research scholar. The Research Supervisor of the research scholar shall be the convener of the Doctoral Committee. The Co- Supervisor, if applicable, shall also be a member. In the absence of Research Supervisor, the Co-Supervisor can be the convenor of the Doctoral Committee. **The Doctoral Committee Meeting shall be conducted in presence of Ph.D Research Supervisor and the nominated external expert.** If a Doctoral Committee member is away from his/her place of work for a longer period, the Research Supervisor shall request for an alternate member from the Panel of experts submitted.

13.1 Functions of Doctoral Committee (Research Advisory Committee as per UGC):

The Research Supervisor of the Ph.D. scholar concerned shall be the Convener of this committee, and this committee shall have the following responsibilities:

- i. To review the research proposal and finalize the topic of research.
- ii. To guide the Ph.D. scholar in developing the study design and methodology of research and identify the course(s) that he/she may have to do.
- iii. To periodically review and assist in the progress of the research work of the Ph.D. scholar.

Each semester, a Ph.D. scholar shall appear before the Doctoral Committee in the Karpagam Academy of Higher Education campus to make a presentation and submit a brief report on the progress of his/her work for evaluation and further guidance. The Doctoral Committee shall submit its recommendations along with a copy of Ph.D. scholar's progress report to The Registrar, Karpagam Academy of Higher Education. A copy of such recommendations shall also be provided to the Ph.D. scholar.

The first Doctoral Committee meeting of a scholar which shall be conducted within one month from the date of registration shall decide the topic of research, work plan and the course work to be undertaken by the scholar. The Doctoral Committee shall also submit a Panel of three Experts from recognized institutes (other than Parent Institution) along with their CV for question paper setting and evaluation relating to Part –I Examinations.

The scholar shall be permitted for pre-submission presentation after recommended by the Final Doctoral Committee Meeting. The synopsis to be submitted only after the successful completion of pre-submission presentation. The time gap between the date of pre-submission and the date of submission of synopsis shall be atleast one month.

14.0 Submission of Progress Report:

Progress report is to be submitted every half-year period during the entire duration of Ph.D., programme

15.0 Course of Study:

The course of study of Ph.D., programme consists of Part I Course work and Part II Research work.

15.1 Part I:Course Work

Course work comprises the following three theory papers.

Paper I : Research Methodology and Pedagogy

Paper II : Research and Publication Ethics

Paper III : Special Paper (Research Area)

15.2 The course work shall be treated as a prerequisite for Ph.D., preparation. The credit assigned to the Ph.D. course work shall be 12 credits.

Paper I on Research Methodology and Pedagogy a minimum of four credits shall be assigned which could cover areas such as quantitative methods, computer applications, research ethics and review of published research in the relevant field, training, field work, etc.

Paper II Research and Publication Ethics and Paper III Special Paper carry 4 credits each. The total number of special papers in each discipline shall be 10. The candidate has to select one among the 10, in consultation with the Research Supervisor.

The Credit requirement for the Ph.D. coursework is a minimum of 12 credits, including a "Research and Publication Ethics" course as notified by UGC vide D.O. No. F.1- 1/2018(Journal/CARE) in 2019 and a research methodology course. The Research Advisory Committee can also recommend UGC recognized online courses as part of the credit requirements for the Ph.D. programme.

Ph.D. scholars, irrespective of discipline, shall be trained in teaching / education / pedagogy / writing related to their chosen Ph.D. subject during their doctoral period. Ph.D. scholars will also be assigned 4-6 hours per week of teaching/research assistantship for conducting tutorial or laboratory work and evaluations.

The Full-Time scholar is required to write all the three courses within six months and for Part time the research scholar has to write within one year, from the date of registration, but has to pass all the courses within a maximum of one and half years (three attempts). If the scholar fails to complete course work within one and half years (three attempts) his/her registration will stand automatically cancelled.

15.3 A Ph.D., scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC 10 point scale in the course work in order to be eligible to continue the programme and submit the dissertation/thesis.

The pattern of question paper for course work for Ph.D., programme is given below.

Pattern of Question Paper (Common for FASCM /FoE/FoP)(For Course Work in Ph.D, Programme)

Part – A (5 X 7 = 35 marks - Answer any FIVE out of Seven)

Part – B (5 X 10 = 50 marks - Answer any FIVE out of Ten)

Part – C (1 X 15 = 15 marks - Compulsory Question)

15.4. Part II: Research Work

Upon satisfactory completion of course work and obtaining the marks/grade prescribed, the Ph.D., scholar shall be required to undertake research work. The Ph.D., candidates shall select an original research topic within the chosen area of research specialization. At the end of the minimum period of duration the candidates are eligible to submit the thesis.

16.0 Publication of Articles

Before sending the articles for publication, the article/manuscript is to be submitted to Scrutiny Committee for language and technical scrutiny with a fee of ₹450 per article. After publication, the candidate has to submit the copy of his/her article to the members of the Doctoral Committee.

16.1 Publication of a minimum of two articles is mandatory for submission of a thesis.

16.2 Condition for submission of thesis:

It is Mandatory for the Ph.D., Scholars to publish two research articles for submission of his/her of Ph.D., thesis as mentioned below:

- (i) Engineering, Science and Pharmacy: One article should be in SCI / SCIE / Web of Science and another one in Scopus
- (ii) Commerce, Management, Arts: One in Scopus and another one in Peer reviewed / UGC care listed Journals
- (iii) To attend at-least two timeline presentations and two annual research congress

17.0 Pre-Submission Presentation

The Pre-submission will be permitted only when the research scholar has either published his/her article or it has been accepted for publication provided the date of publication of the article is given in the acceptance letter for publication in an approved Journal. All the published papers by the scholar shall have name of the Research Supervisor and Karpagam Academy of Higher Education. Papers without the name of the Research Supervisor and Karpagam Academy of Higher Education will not be accounted. The Research Scholar should be one among the first two authors in the paper.

Prior to submission of the synopsis, the scholar shall make Pre-submission presentation and it is open to all faculty members and research students, and their feedback and comments if any may suitably be incorporated in the draft synopsis and thesis in consultation with Doctoral Committee. A notification may be issued to all the Departments regarding the same. The report in the prescribed format shall be forwarded

by the Research Supervisor to the Research section on the same day along with the certificate of bonafide research work done.

18.0. Plagiarism (Turnitin Software):

18.1 The research scholar has to submit his/her synopsis and thesis for checking plagiarism on payment of prescribed fee. If the percentage of plagiarism is more than 10% the thesis will not be accepted for submission. Same is the case for manuscripts and synopsis.

18.2 Further while submitting for evaluation, the thesis shall have an undertaking from the research scholar and a certificate from the Research Supervisor attesting the originality of the work, vouching that the plagiarism is less than 10% and that the work has not been submitted for the award of any other degree/diploma of the same Institution where the work was carried out, or any other Institution.

18.3 In any case if scholars have committed an act of plagiarism with more than 10%, his/her Thesis / degree shall be withdrawn and his / her registration shall be cancelled and also, he / she shall be debarred to register for any other programme in the Karpagam Academy of Higher Education. Appropriate legal action shall also be initiated.

18.4 Research Supervisor ship of the Supervisor will also be withdrawn.

19.0. Submission of synopsis

The research scholar who has successfully completed the course work alone is eligible to submit the synopsis. He/she shall be permitted to submit the synopsis during the last quarter of the eligible minimum period on the recommendation of the Final Doctoral Committee Meeting and after Pre-submission Presentation. The research scholar shall submit five copies of synopsis with a soft copy along with prescribed application through the Research Supervisor to the Controller of Examinations. Synopsis shall be accepted only when the Panel of Examiners is submitted to Controller of Examinations. In case the panel is exhausted, the Vice Chancellor can either call for a fresh panel of examiners from the Research Supervisor or nominate examiner(s).

19.1 Submission of thesis

Five copies of thesis with flexible cover along with soft copy (PDF format) shall be prepared in accordance with the format and specifications prescribed. Thesis shall be submitted together with the prescribed application form along with the prescribed fee, within three months from the date of submission of the synopsis.

All the Ph.D., scholars are encouraged to submit their thesis within the stipulated time period. However, for those candidates who have submitted synopsis but unable to submit the thesis within the stipulated period, an extension of three months will be allowed on payment of ₹ 2000/- as extension fee. If the candidate fails to submit within the extension period of three months, he / she has to pay full year fee for all the years till he / she submits the thesis.

20.0 Evaluation of the Thesis

- 20.1 The Ph.D. thesis submitted by a Ph.D. scholar shall be evaluated by his/her Research Supervisor and atleast two external examiners who are experts in the field. Such examiner(s) should be academics with a good record of scholarly publications in the field. Wherever possible, one of the external examiners should be chosen from outside India. The viva-voce board shall consist of the Research Supervisor and at least one of the two external examiners and may be conducted offline.
- 20.2 The viva-voce of the Ph.D. scholar to defend the thesis shall be conducted if both the external examiners recommend acceptance of the thesis after incorporating any corrections suggested by them. If one of the external examiners recommends rejection, the Institution concerned shall send the thesis to an alternate external examiner from the approved panel of examiners, and the viva-voce examination shall be held only if the alternate examiner recommends acceptance of the thesis. If the alternate examiner does not recommend acceptance of the thesis, the thesis shall be rejected, and the Ph.D. scholar shall be declared ineligible for the award of a Ph.D.
- 20.3 Each member of the Board shall adjudicate the thesis and shall submit a detailed report as given in the prescribed form on the merits and demerits of the thesis and finally explicitly indicate whether the thesis is Recommended or Recommended for Resubmission or Not Recommended within a period of 6 months.
- 20.4 If the evaluation report from the examiner is not received within 6 Months, another examiner will be appointed from the panel of examiners.
- 20.5 As soon as the reports of evaluation are received from the examiners by Controller of Examinations, they shall be sent to the Research Supervisor (Convener) for consolidation of the reports.
- 20.6 If the examiners insist on corrections to be made in the thesis, the same shall be made before appearing for the Public viva-voce examination, along with a certificate as given below from the Research Supervisor that the corrections have been satisfactorily carried out.

A Ph.D. scholar shall submit the thesis for evaluation, along with (a) an undertaking from the Ph.D. scholar that there is no plagiarism and (b) a certificate from the Research Supervisor attesting to the originality of the thesis and that the thesis has not been submitted for the award of any other degree/diploma to any other Higher Educational Institution.

CERTIFICATE

This is to certify that all corrections, modifications suggested by the examiners of the thesis entitled, “.....”submitted by Mr./Ms have been incorporated and resubmitted. The thesis may be accepted.

Signature of the Research Supervisor

- 20.7 In case of a thesis, which has not been specifically ‘recommended’ or ‘not recommended’ but revision and resubmission is suggested, the thesis shall be

revised and the thesis duly certified by the Research Supervisor be sent to the same examiner who has suggested the revision for obtaining the recommendation.

- 20.8 The time-limit to resubmit the revised thesis, as per the suggestions for revision and resubmission of thesis by the examiner(s) shall not exceed twelve full months. A candidate shall not ordinarily be permitted to submit the thesis for the degree or to take the public viva-voce examination on more than two occasions.
- 20.9 The viva-voce shall be conducted by the Research Supervisor and atleast by one of the two external examiners, on the critiques given in the evaluation report. It is open to DC Members, all faculty members, research scholars and other interested experts/researchers.
- 20.10 The first notification for Ph.D., viva-voce shall be issued only after the Research Supervisor of the candidate, receives the approval from the authorities to issue the first notice.
- 20.11 15 clear days' notice may be required to be given for issue of the second notification from the date of the first notification. Similarly, 15 clear days are required to be given for conducting the public viva-voce from the date of issue of the second notification.
- 20.12 The Research Supervisor shall fix the date and time of the viva-voce in consultation with the External Examiner and Head of the Department concerned. After conducting the public viva-voce, the Research Supervisor shall convey to the Controller of Examination, the result of such examination endorsed by the External Examiner along with list of participants, recommending for the award of Ph.D.,
- 20.13 A candidate who is not successful in the Public viva-voce may be permitted to undergo the Public viva-voce second time, within a period of three months but not before one month after the first viva-voce.
- 20.14 The entire process of evaluating a Ph. D. thesis, including the declaration of the viva-voce result, within a period of six (6)months from the date of submission of the thesis.

21.0 Award of the Degree

A candidate who has successfully completed the public viva-voce shall be declared to have qualified for the award of Ph.D., degree of Karpagam Academy of Higher Education. Viva voce evaluation of the thesis shall be conducted offline. Prior to actual award of the degree, provisional certificate shall be issued after approval by the Board of Management.

Issuing a Provisional certificate:

Prior to the actual award of the Ph.D. degree, the degree- awarding Higher Educational Institution shall issue a provisional certificate to the effect that the Ph.D. is being awarded in accordance with the provisions of these Regulations.

Award of Ph.D. degrees:

Award of degrees to candidates registered for the Ph.D. programme on or after November,07, 2022 shall be governed by University Grants Commission (Minimum Standards and Procedures for Award of Ph.D. Degree) Regulations, 2022.

Depository with INFLIBNET:

Following the successful completion of the evaluation process and before the announcement of the award of the Ph.D. degree(s), the Karpagam Academy of Higher Education shall submit an electronic copy of the Ph.D. thesis to INFLIBNET, for hosting the same so as to make it accessible to all the Higher Educational Institutions and research institutions.

22.0. Cancellation of Registration

The registration of a research scholar shall stand cancelled if -

- The research scholar has not paid the prescribed fee within the stipulated time;
- The Full-Time candidate has not completed his course work within one and half years (three attempts) and Part-Time candidates within two years (three attempts)
- The progress report is not submitted consecutively or the progress reports are not satisfactory as decided by the Doctoral Committee;
- The maximum period stipulated for the programme exceeded; and
- The research scholar withdraws from the course voluntarily.

In all the above cases, the fees paid by the research scholar shall be forfeited. However, such candidates may be permitted for fresh registration.

23.0 Publication of the thesis

The candidate may publish his/her thesis on the recommendation of the Research Supervisor in the format as given below and after getting permission from the Karpagam Academy of Higher Education. At least ten copies of the published work should be given to the Karpagam Academy of Higher Education at free of cost Permission for publication of the thesis should be obtained within FIVE years of the award of the degree. All the publications arising out of the research work shall have the name of Karpagam Academy of Higher Education. Due credit shall be given to the Institution and Research Supervisor if any patent is filed out of the work undertaken during the period of research.

[CERTIFICATE]

This is to certify that the thesis entitled, “.....” submitted by Mr. / Ms. does not contain any objectionable material and is a record of original and independent research work done by him/her. Hence the thesis is fit for publication, if the candidate so desires.

Signature of the Research Supervisor

24.0 Conferment of the Degree

Candidates who qualify for the Ph.D., degree shall be awarded the degree in the discipline in which he/she has registered.

25. Preparation and Submission of Synopsis and Thesis

25.1 Preparation of Synopsis

Synopsis should outline the research problem, the methodology adopted and the summary of the findings. The synopsis should not exceed 10 pages from the first page to the last page including the List of Publications. The sequence in which the Synopsis should be arranged is as follows:

- i. Cover Page and Title page (as shown in the Annexure I) (Page No.17& Page No.18)
- ii. Text divided into suitable Headings (numbered consecutively)
- iii. References
- iv. List of Publications (those published / accepted for publication in Journals and papers presented in Conferences / Symposia)
- v. Standard A4 size (297mm x 210mm) paper shall be used for preparing the copies.

Top edge: 30 mm

Bottom edge: 30 mm

Left side: 35 mm

Right side : 25 mm

The Synopsis should be prepared on good quality white bond paper preferably not lower than 80 gsm. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12. All page numbers (Arabic numbers) should be typed without punctuation on the upper right hand corner. Synopsis should be bound using flexible cover of thick white art paper. The cover should be printed in black letters and the text for printing should be identical to what has been prescribed for the title page. References, if any cited in the text of the Synopsis, should be listed at the end of the Synopsis under the heading "REFERENCES" as per the following format:

References

I. References cited from published research papers should be in the following format:

a. Single author

Wattenberg, L.W.,2008.Chemoprevention of cancer. Cancer Research., 45:1-8.

b. Two authors

Defendi, V. and B. Pearson, 2012. Quantitative estimation of succinic dehydrogenase activity in a single microscopic tissue section. Journal, Histochemistry, Cytochemistry, 3: 61-64.

c. More than two authors

Kristan K., M. Kotnik, M. Oblak and U.J. Urleb, 2009. New high throughput fluorimetric assay for discovering inhibitors of UDP-N-acetylmuramyl-l-alanine: d-glutamate (MurD)lLigase.Biomol. Screen, 14: 412-418.

II. References cited from a published book

Vuković-Gačić, B. and D.Simić, 2010. Identification of natural antimutagens with modulating effects on DNA repair, In: Antimutagenesis and anti-carcinogenesis mechanisms III (Eds. G.Bronzzeti, H. Hayatsu, S. De Flora, M.D. Waters and D.M. Shankel), Plenum Press, New York,269-277.

III. References cited from approved Thesis / Dissertation

Ratnakar, P., 2012. Biochemical studies of *Allium sativum* Linn. (Garlic). Ph.D.,Thesis, DelhiUniversity. P. 87.

25.2 Preparation of Thesis

A. General

In general, the Thesis shall be presented, in an organized and scholarly fashion, the original research work of the research scholar.

B. Size of Thesis

The size of the Thesis should not exceed 250 pages of typed matter reckoned from the first page of Chapter 1 to the last page of the Conclusion Chapter exclusive of tables, photographs, figures, references & appendices.

C. Sequence of the Contents of the Thesis

The sequence in which the Thesis material should be arranged is as follows:

- i. Cover Page and Title page (as shown in Annexure II Page 19& Page 20)
- ii. Bonafide Certificate (as shown in Annexure III Page 21)
- iii. Declaration and Certificate from the Research Supervisor and co-Research Supervisor (if any)(as shown in Annexure IV Page 22& V Page 23)
- iv. Acknowledgement
- v. Table of Contents
- vi. List of Symbols and Abbreviations.
- vii. Abstract
- viii. Chapters
- ix. References
- x. Appendices
- xi. List of Publications- only title of the paper with ISSN and other details.

D. Page Dimensions and Margin

The dimensions of the final bound Thesis report (5 copies) should be 290 mm x 205mm. Page margins: Tables and Figures should conform to the margin specifications. Large sized figures may be as it is or otherwise reduced to the appropriate size before insertion.

E. Bonafide Certificate

The Bonafide Certificate shall be typed in **double line spacing** using Font Style Times New Roman and Font Size 12 as per the format shown in Annexure III. The certificate shall carry the Supervisor's signature and shall be followed by the Supervisor's name, academic designation, department and full address of the institution where the Research Supervisor has guided the research scholar.

F. Acknowledgement

It should be brief and should not exceed two pages when typed in double spacing. The scholar's signature shall be made at the bottom right end above his / her name typed in capitals.

G. Table of Contents

The Table of contents should list all captions from items v to xi following it. The title page, Bonafide Certificate and Declaration Certificate will not find a place among the items listed in the Table of Contents but the page numbers must be typed in lower case Roman letters in all the pages (excepting No. i on the Title page). One and a half spacing should be adopted for typing the matter under Table of Contents.

H. List of Symbols and Abbreviations

One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations, etc. should be used. The list should be arranged alphabetically with respect to the contents on the right side.

I. Abstract

Abstract should be an essay type of narration not exceeding four pages outlining the research problem, methodology used for solving it and a summary of the findings. This shall be typed in double line spacing using Font Style Times New Roman and Font Size 12.

J. Chapters

The chapters may be broadly divided into Introduction, Review of Literature, Material and Methods, Results, Discussion, Summary and References.

- a. Each chapter should be given an appropriate title.
- b. Tables and Figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
- c. Footnotes should be used sparingly. They should be typed single space and placed directly underneath in the very same page which refers to the material they annotate.

K. List of References

The listing of references cited in the text should be typed in single line spacing starting from 4lines spaces below the heading "REFERENCES". The reference material should be listed in the alphabetical order of the first author of each reference. The name of the author / authors should be immediately followed by the other details and year. The cited references in the Text should be listed "REFERENCES" as per the specified format:

L. Appendices

Appendices are provided to give supplementary information's relevant to the research work done by the candidate.

M. List of Publications

Reprints / Photostat copies of research papers already published / accepted for publication in Journals are to be attached in chronological orders and these pages need not be numbered. The heading "List of Publications" alone must find a place in the Table of Contents without page numbers for this item only.

N. Tables and Figures

"Table" means tabulated numerical data in the body of the Thesis as well as in the appendices. All other non-verbal material used in the body of the Thesis and appendices such as charts, graphs, maps, photographs and diagrams may be designated as Figures.

- a. A Table or Figure including caption should be accommodated within the prescribed margin limits and appear on the page following the page where their first reference is made.
- b. Tables and Figures on half page or less in length may appear on the same page along with the text. However, they should be separated from the text both above and below by triple spacing.

- c. All Tables and Figures should be prepared on the same paper or material used for the preparation of the rest of the Thesis.
- d. Two or more small Tables or Figures may be grouped, if necessary, in a single page.
- e. Wherever possible, the photograph(s) shall be reproduced on a full sheet of photographic paper or colour xerox.
- f. More than one photograph can be included in a page.
- g. Samples of Fabric, Leather, etc., if absolutely necessary may be attached evenly in a page and fixed/pasted suitably and should be treated as Figures.

O. Typing Instructions

General

This section includes additional information for final typing of the Thesis. The impressions on the typed / photo-stated / printed copies should be black in colour.

A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page.

The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12. Single spacing should be used for typing:

- (i) Long Tables
- (ii) Long quotations
- (iii) Foot notes
- (iv) Multiline captions
- (v) References

All quotations exceeding one line should be typed in an indented space – the indentation being 15 mm from either side of the margin.

P. Page Numbering

All page numbers (small case Roman numerals or Arabic numbers) should be typed without punctuation on the **upper right hand corner** 20 mm from the top with the last digit of the number in line with the right hand margin. The preliminary pages of the Thesis (such as Title page, Bonafide Certificate, Declaration and Certificate, Table of Contents, Acknowledgement, List of Symbols and Abbreviations and Abstracts) should be numbered in lower case Roman numerals. The Title page will be numbered as (i) but this should not be typed on the page. The page immediately following the Title page shall be numbered as (ii) and it should appear **at the top right hand corner** as already specified. Pages of main text, starting with Chapter 1 should be consecutively numbered using Arabic numerals.

Q. Numbering of Chapters, Divisions and Sub-Divisions

The numbering of chapters, divisions and sub-divisions should be done using Arabic numerals only and further decimal notation should be used for numbering the divisions and sub-divisions within a chapter. For example, sub-division 4 under division 3 belonging to chapter 2 should be numbered as 2.3.4. The caption for the sub-division should immediately follow the number assigned to it.

Every chapter beginning with the first chapter should be serially numbered using Arabic numerals. Appendices, included if any, should also be numbered in an identical manner starting with Appendix 1.

R. Numbering of Tables and Figures

Tables and Figures appearing anywhere in the Thesis should bear appropriate numbers. The rule for assigning such numbers is illustrated by an example. Thus, if a Figure in Chapter 3, happens to be the fourth then assign 3.4 to that Figure. Identical rules apply for Tables except that the word Figure is replaced by the word Table. If Figures (or Tables) appear in appendices, then Figure 3 in Appendix 2 will be designated as Figure A 2.3. If a table is to be continued into the next page this may be done, but no line should be drawn underneath an unfinished Table. The top line of the Table continued into the next page should, for example read Table 2.1 (continued) placed centrally and underlined.

S. Numbering of Equations

Equations appearing in each Chapter or Appendix should be numbered serially, the numbering should commence afresh for each Chapter or Appendix. Thus, for example, an equation appearing in Chapter 3, if it happens to be the eighth equation in that Chapter should be numbered as (3.8) thus (3.8) While referring to this equation in the body of the Thesis it should be referred to as Equation (3.8).

T. Binding Specifications

Thesis should be bound with **black calico cloth** and using flexible cover of thick white art paper. The cover should be printed in black letters and the text for printing should be identical to what has been prescribed for the title page.

Soft copy of the Thesis (PDF format) written in CD (2 Nos.) should be submitted for Karpagam Academy of Higher Education archives.

Revision of Regulation:

The Karpagam Academy of Higher Education may from time to time, amend the Regulations based on UGC Regulations if found necessary.

ANNEXURE I

Specimen of Cover Page and Title Page

ANTIOXIDANT ACTIVITY OF INDIAN MEDICINAL PLANTS FROM WESTERN GHATS

Font Size 18><1.5 line spacing>

SYNOPSIS

Submitted by

<Italic>

RAGHAVENDRA S A

in partial fulfilment of the requirements for the award of the degree of

<Italic><1.5 line spacing>

DOCTOR OF PHILOSOPHY

IN

BIOTECHNOLOGY



DEPARTMENT OF BIOTECHNOLOGY

Karpagam Academy of Higher Education

(Deemed to be University) (Established Under Section 3 of UGC Act, 1956)

(Accredited with A+ Grade by NAAC in the Second Cycle)

Pollachi Main Road, Eachanari Post, Coimbatore – 641 021, Tamil Nadu, India

<1.5 line spacing>

December, 2022

**ANTIOXIDANT ACTIVITY OF INDIAN MEDICINAL PLANTS FROM
WESTERN GHATS**

SYNOPSIS

Submitted by

RAGHAVENDRA S A

in partial fulfilment of the requirements for the

award of the degree of

**DOCTOR OF PHILOSOPHY
IN
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December, 2022

ANNEXURE II

Specimen of Cover Page and Title Page

**ANTIOXIDANT ACTIVITY OF INDIAN MEDICINAL PLANTS FROM WESTERN
GHATS**

<1.5 line spacing>

THESIS

Submitted by

<Italic>

RAGHAVENDRA S A

in partial fulfilment of the requirements for the award of the degree of

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December, 2022

ANNEXURE IV

Specimen of Declaration

DECLARATION

I _____ hereby declare that the thesis entitled
“ _____ ”
submitted to the Karpagam Academy of Higher Education, in partial fulfillment of the
requirements for the award of the Degree of Doctor of Philosophy in
_____ is a record of bonafide and
independent research work done by me during the period from ____/____/____ to ____-
____/____/____ under the supervision and guidance of
Dr. _____, Department of
_____ at Karpagam Academy of Higher Education, and it has not
formed the basis for the award of any Degree / Diploma / Associate ship / Fellowship or other
similar title to any candidate in Karpagam Academy of Higher Education so far.

Signature of the Research Scholar

ANNEXURE V

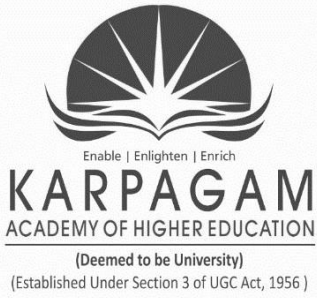
Specimen of Certificate

CERTIFICATE

This is to certify that the thesis entitled “_____” submitted to the Karpagam Academy of Higher Education, in partial fulfillment of the requirements for the award of the Degree of Doctor of Philosophy in _____ is a record of bonafide research work done by Mr. / Ms. _____ during the period from ____/____/____ to ____/____/____ of his / her study in the Department of _____ at Karpagam Academy of Higher Education, under my supervision and guidance and the thesis has not formed the basis for the award of any Degree / Diploma / Associate ship / Fellowship or other similar title to any candidate of Karpagam Academy of Higher Education so far.

**Countersigned
Head of the Department**

Signature of the Research Supervisor



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FORMAT I

Progress Report of Research Scholar

(To be submitted once in six months)

1. Programme : Ph.D., FT/PT
2. Subject :
3. Name & Regn.No. of the Research scholar:
4. Title of Ph.D., Research work :
5. Report No./Month/Year :

No.	Month	Year

6. Brief report about the work carried

out by the Research scholar :

- a. Article/s published _____ No's (Attach copies)
- b. Seminars/Conferences attended _____ (Attach certificate copies)
- c. Course work: Completed / Not Completed (Attach copy of Mark sheet)
- d. Course fee: Paid till _____(copies of receipts)

7. Research Guide's Comment :

Signature of the Research Scholar
(with Name & address)
Mobile No.:
E-mail id:

Signature of the Research Supervisor
(with Name & address)
Mobile No.:
E-mail id:



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FORMAT II

Request for Pre-submission presentation

Check list

1. Name of the research scholar with Registration Number :
2. Name of the Research Supervisor :
Designation :
Department :
3. (a) Whether the minimum period completed? : Yes/No (Refer Registration Communication)
(b) If extension obtained, attach particulars :
4. Whether course fee paid for all the years : Yes/No (Attach No Dues Certificate)
5. Title of Ph.D. Research work :
6. Details of the Part I Course work :
(Enclose necessary documents)
7. Number of DC Meetings attended (Annually 2) :
8. Total No. of 6 months performance reports submitted : 6/8/10/12
9. (a) No. of Time-line presentations attended :
(b) No. of Annual Research Congress attended :
10. (a) Minimum No. of Research articles to be published : 2 as per KAHE regulation
(b) No of articles published by the scholar :
(Attach photocopies of reprints)
11. Whether submission of thesis is recommended
at the Final Doctoral Committee Meeting and
date of DCM :
12. Communication skill* : Good/Satisfactory/Need improvement
(To be judged based on the DC Meeting, (Tick whichever is applicable)
Time line Presentation and
Annual Research Congress)

**Signature of the Research Scholar
Supervisor**

Signature of the Research

*The Guide/HOD shall give specific remarks about the communication skill of the scholar. At the time of Pre-submission Presentation, if it is found that the Communication skill of the scholar is less than average, the period of submission may be extended for one more year and the scholar shall be advised to improve his/her Communication skill and may be presented again.



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FORMAT III

KAHE / RS / Rx /Ph.D./Dept./ Pre-Sub / xxxx / 2022/

Date: _____

Pre-Submission presentation of the Ph.D. research - Notification

I am by direction to inform you that a Pre-submission Presentation of the Ph.D., thesis is arranged for the candidate _____ working under the supervision of _____, Designation, Department of _____, Karpagam Academy of Higher Education, Coimbatore – 641 021.

Ph.D. Thesis Title: “ _____ ”.

All members of faculty, experts and all interested persons are requested to attend the aforesaid Pre-submission Presentation.

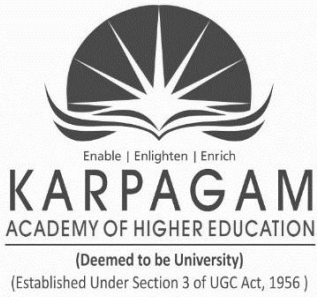
Venue :
Date :
Time :

Registrar

To

All Head of the Department of _____, requested to make necessary arrangement to conduct the programme.

Kindly circulate to Dean / Director / Research Supervisor / Research Scholars



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FORMAT - IV

DEPARTMENT OF _____
Pre-submission Presentation Report

- | | |
|---|---|
| | Date: |
| 1. Name of the Research Scholar | : |
| 2. Register Number of the Research Scholar | : |
| 3. Ph.D., programme in | : |
| 4. Department | : |
| 5. Name of the Research Supervisor | : |
| Designation | : |
| Department | : |
| 6. Presentation date & Venue | : |
| 7. No. of articles published by the scholar | : |
| 8. Number of members present in
the presentation (enclose the
attendance sheet) | : |
| 9. A report on the Question & Answer Session
(in the enclosed format) | : |
| 10. Comments of the Supervisor | : |
| (a) On the composition of the Thesis chapters | : Adequate/Needs to be revised. |
| (b) On the Communication skill*
(additional sheets may be used) | : Good/Satisfactory/Needs improvement
(Tick whichever is applicable) |
| 11. After the Pre-submission
Presentation whether the scholar
may be permitted to submit the Thesis | : Permitted/Extended for one year
(Strike out whichever is not applicable) |

Signature:

Research Scholar

Research Supervisor

HOD

Dean

*(At the time of Pre-submission Presentation, if it is found that the Communication skill of the scholar is less than average and needs improvement, the period of submission may be extended for one more year and the scholar shall be advised to improve his/her Communication skill and may be presented again.)



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FORMAT – IV Annexure

Pre-submission Presentation: A brief report on the Question & Answer Session

Answers should be brief and relevant to the question. If needed, additional sheets may be used

Topic of the Research work:

Q1.

Answer:

Q2.

Answer:

Q3.

Answer:

Q4.

Answer:

Q5:

Answer:

Signature of

Research Scholar

Research Supervisor



Enable | Enlighten | Enrich
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This is a Format only (Neatly typed, aligned and duly signed form to be submitted)

FORMAT V

Pre-submission presentation Certificate

Name & Reg. No. of the research scholar :

Subject :

Date of Presentation :

Certified that the above research scholar under my guidance has presented his/her research work during Pre-submission Presentation and his/her presentation is _____ . All the suggestions made by the participants are taken into consideration and important suggestions will be included in the thesis entitled:

“ _____
_____ ”.

Place :

Date :

**Signature of the Research Supervisor
(Name & Address)**

Counter Signed:

**HOD
(Name & Seal)**



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This is a Format only (Neatly typed, aligned and duly signed form to be submitted)

FORMAT - VI

Submission of Ph.D., Thesis: Check List

1. Name of the research scholar with Registration Number :
2. Name of the Research Supervisor :
Designation :
Department :
3. (a) Whether the minimum period completed? : Yes/No (Refer Registration Communication)
4. (b) If extension obtained, attach particulars :
5. Whether course fee paid for all the years : Yes/No (Attach No Dues Certificate)
6. Title of Ph.D. Research work :
7. Details of the Part I Course work :
8. (Enclose necessary documents)
9. Number of DC Meetings attended (Annually 2) :
10. Total No. of 6 months performance reports submitted : 6/8/10/12
(a) No. of Time-line presentations attended :
(b) No. of Annual Research Congress attended :
11. (a) Minimum No. of Research articles to be published : 2 as per KAHE regulation
(b) No of articles published by the scholar :
12. Whether submission of thesis is recommended at the Final Doctoral Committee Meeting and date of DCM :
13. Date of Pre-Submission Presentation made :
(Attach a certificate from the supervisor duly countersigned by the HOD)
14. Probable date of submission of Synopsis :
15. Expected date of submission of Thesis :

Signature of:

Research Scholar

Research Supervisor

HOD

For Office of the Research use:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
---	---	---	---	---	---	---	---	---	----	----	----	----	----

Recommendation for submission: **Recommended / Not recommended**

Addl. Director, Research

Director, Research



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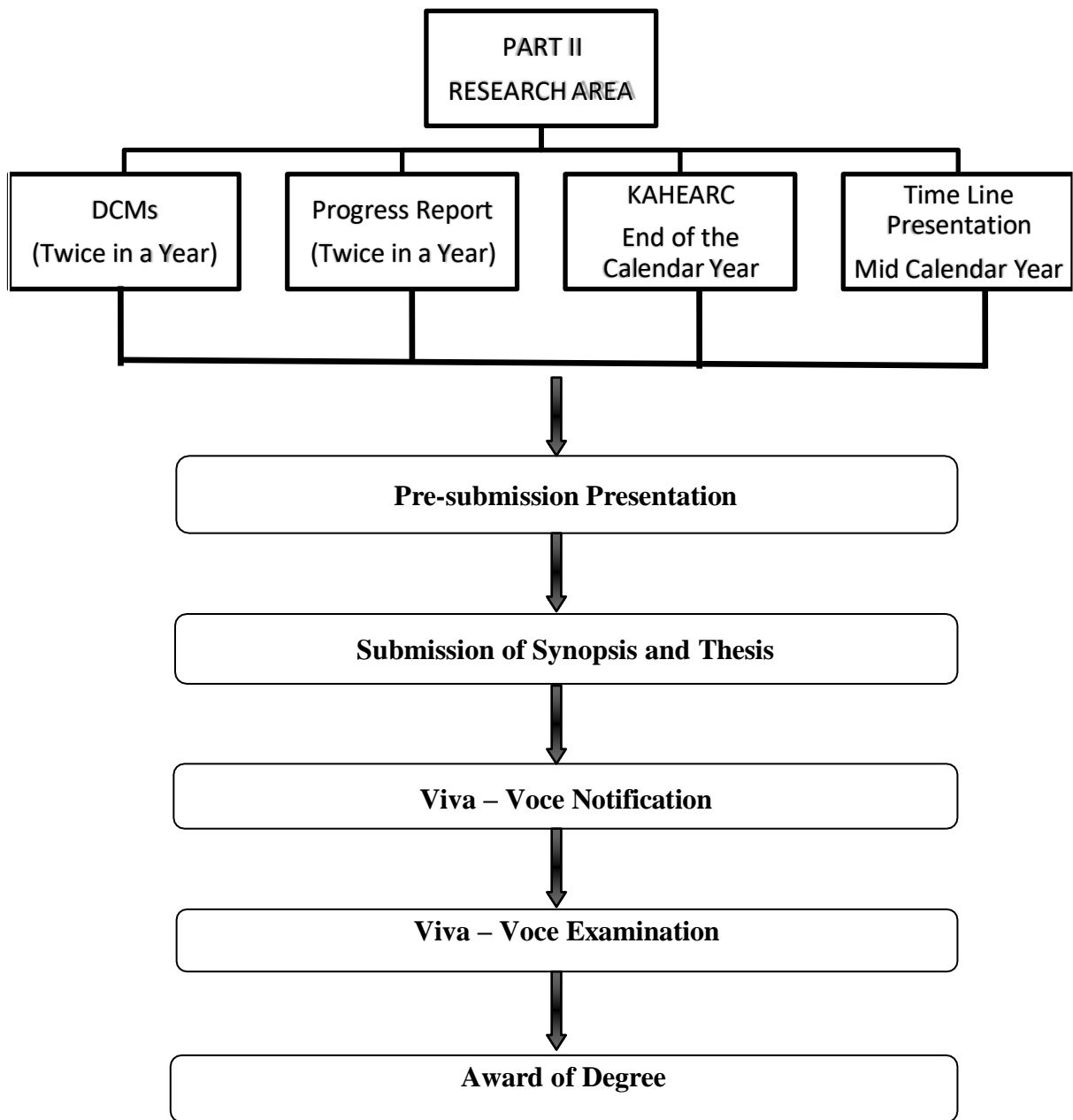
Certificate of Plagiarism

Certified that the thesis entitled “_____” for
the award of Ph.D., degree has undergone Plagiarism check through Turnitin software and the
level of plagiarism is _____.

Signature of the Research Scholar

Signature of the Research Supervisor

Professor in- charge for Plagiarism Test



Publications terminology

1. Impact Factor

The Impact Factor of an academic journal is a measure which reflects the average number of citations to recent articles published in that Journal.

- It is a measure of the relative importance of a journal in a given field.
- It was devised by **Mr. Eugene Garfield**, the founder of the **Institute for Scientific Information**.
- Impact factor is calculated yearly starting from 1975 for those journals which are indexed in the **Journal Citation Reports**.
- Normally, the impact factor for 2021 is published in 2022.
- It is a journal metric and not to be used to assess an individual researcher or research institution.

Calculation

Example: If a Journal has an impact factor of 3 in the year 2022; it means that each paper published in that journal during the years 2020 and 2021 had received an average of 3 citations in 2022.

Let A= The number of times that articles published in that journal in and 2021, were cited by articles in indexed journals during 2022.

B= The total number of “citable items” (usually, articles, reviews and proceedings) published in that journal in 2020 and 2021.

Then, Impact factor (in 2022) = $\frac{A}{B}$

2. HIndex

The h-index is an index that attempts to measure both the productivity and impact of the published work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The index can also be applied to the productivity and impact of a group of scientists, such as a department or university or country, as well as a scholarly journal. The index was suggested by Jorge E. Hirsch, a physicist at UCSD (University of California, San Diego), as a tool for determining theoretical physicists' relative quality and is sometimes called the Hirsch index or Hirsch number. The h-index serves as an alternative to more traditional journal impact factor metrics in the evaluation of the impact of the work of a particular researcher.

3. Scopus

Scopus, officially named **SciVerse Scopus**, is a bibliographic database containing abstracts and citations for academic journal articles. It covers nearly 20,500 titles from over 5,000 international publishers, of which 19,500 are peer-reviewed journals in the scientific, technical, medical, and social sciences (including arts and humanities). It is owned by **Elsevier** and is available online by subscription. Since Elsevier is the owner of Scopus, and is also one of the main international publishers of scientific journals, Elsevier established the independent and international Scopus Content Selection and Advisory Board to prevent a potential conflict of interest in the choice of the periodicals to be included in the database and to maintain an open and transparent content coverage policy. The board consists of scientists and subject librarians from all scientific disciplines and geographical areas, whose interest is to access any relevant information regardless of the publishers.

SciVerse

SciVerse is a platform for accessing scientific information from certain databases and the web. It is published by **Elsevier**. It provides access to 2,500 journals and 11,000 books with about 500 thousand additions each year.

"**SciVerse**" globally indexes articles, books, theses, abstracts, patents and sifts through web results, from publishers, universities and professional organizations.

4. International Standard Serial Number

An **International Standard Serial Number (ISSN)** is a unique eight-digit number used to identify a print or electronic periodical publication. Periodicals published in both print and electronic form may have two ISSNs, a **print ISSN (p-ISSN)** and an **electronic ISSN (e-ISSN or eISSN)**. The ISSN system was first drafted as an ISO international standard in 1971 and published as ISO 3297 in 1975. The ISO subcommittee is responsible for the standard.

Code format

The format of the ISSN is an eight-digit number, divided by a hyphen into two four-digit numbers. The last digit, which may be 0–9 or an X, is a check digit. The ISSN of the journal *Hearing Research*, for example, is 0378-5955, the check digit is 5.

Code assignment

ISSN codes are assigned by a network of ISSN National Centres, usually located at national libraries and coordinated by the ISSN International Centre based in Paris. The International Centre is an intergovernmental organization created in 1974 through an agreement between UNESCO and the French government. The International Centre maintains a database of all ISSNs assigned worldwide, the ISSN Register.

Availability

The ISSN Register is not freely available for interrogation on the web but is available by subscription. There are several routes to the identification and verification of ISSN codes for the general public.

- the print version of a periodical typically will include the ISSN code as part of the publication information
- most periodical websites contain ISSN code information
- derivative lists of publications will often contain ISSN codes; these can be found through on-line searches with the ISSN code itself or periodical title.

5. Peer Review

Peer review is the evaluation of work by one or more people of similar competence to the producers of the work (peers). It constitutes a form of self-regulation by qualified members of a profession within the relevant field. Peer review methods are employed to maintain standards of quality, improve performance, and provide credibility. In academia peer review is often used to determine an academic paper's suitability for publication.

Professional peer review

Professional peer review focuses on the performance of professionals, with a view of improving quality, upholding standards, or providing certification. Professional peer review activity is widespread in the field of health care, where it is best termed as **Clinical peer review**.

Scholarly peer review

Scholarly peer review (also known as **refereeing**) is the process of subjecting an author's scholarly work, research, or ideas to the scrutiny of others who are experts in the same field, before a paper describing this work is published in a journal. The work may be accepted, considered acceptable with revisions, or rejected. Peer review requires a community of experts in a given (and often narrowly defined) field, who are qualified and able to perform impartial review

6. Web of Science

Single research destination to explore the citation universe across subjects and around the world. Web of Science provides access to the most reliable, integrated, multidisciplinary research connected through linked content citation metrics from multiple sources within a single interface. Since Web of Science adheres to a strict evaluation process, one can be assured only the most influential, relevant, and credible information is included - allowing to uncover next big idea faster.

7. Science Citation Index

- The Science Citation Index (SCI) is a citation index originally produced by the Institute for Scientific Information (ISI) and created by Eugene Garfield and was officially launched in 1964. The larger version (Science Citation Index Expanded) covers more than 8,500 notable and significant journals, across 150 disciplines, from 1900 to the present. These are alternatively described as the world's leading journals of Science and Technology, because of a rigorous selection process.
- The index is made available online through different platforms, such as the Web of Science and SciSearch.

8. International Standard Book Number

The **International Standard Book Number (ISBN)** is a unique numeric commercial book identifier based upon the 9-digit **Standard Book Numbering (SBN)** code created by Gordon Foster, Emeritus Professor of Statistics at Trinity College, Dublin, for the booksellers and stationers. The 10-digit ISBN format was developed by the International Organization for Standardization (ISO) and was published in 1970 as International Standard ISO. ISO has appointed the International ISBN Agency as the registration authority for ISBN worldwide and the ISBN Standard is developed under the control of ISO Technical Committee.

ISBN issuance

International Standard Book Numbers issuance is country-specific, in that ISBNs are issued by the ISBN Registration Agency that is responsible for that country or territory. The ranges of ISBNs assigned to any particular country are based on the publishing profile of the country concerned.

DEPARTMENT OF MATHEMATICS
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
RESEARCH PROGRAM – Ph.D. in Mathematics
(2024–2025 Batch and onwards)

Course code	Course Name	Lecture Hours	Credits	Maximum Marks (100)	Page No.
Paper-I					
24RMAT101	Research Methodology and Pedagogy	4	4	100	01
Paper-II					
24RMAT201	Research and Publication Ethics	4	4	100	03
Paper-III					
24RMAT301	Fuzzy Mathematics	4	4	100	05
24RMAT302	Advanced Topics in Fluid Dynamics				07
24RMAT303	Hydrodynamic and Hydromagnetic Stability				09
24RMAT304	Queueing Theory				11
24RMAT305	Advanced Graph Theory				13
24RMAT306	Oscillation Theory of Differential Equations				15
Program Total		12	12	300	

24RMAT101

RESEARCH METHODOLOGY AND PEDAGOGY

Paper-I
4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Understand the fundamentals of research terminology.
- Enrich the concepts of Implicit function theorem.
- Know about the linear oscillations and comparison theorem approaches to research.
- Get the basic working knowledge in LATEX programming.
- Critically analyse methods of evaluation.
- Know about e-learning researches and web-based learning.

COURSE OUTCOMES (COs):

Learners able to:

1. Understand the basic framework of research process.
2. Understand the various research concepts of Implicit functions and extremum problems.
3. Attain mastery in the concept of oscillations of second order equations.
4. Develop LATEX coding for mathematical documentation.
5. Analyze and apply principles of quality teaching and learning practices.
6. Acquiring the knowledge of e-learning researches and web-based learning.

UNIT I

Research Methodology – Meaning of research, Objectives of Research, Motivation in Research – Types of Research – Research approaches – Research methods, Versus Research Methodology – Research process – Scientific method – Criteria for good research, Defining the research problem – Necessity of defining the problem – Techniques involved in defining the problem, Research Design – Meaning and need for Research Design – Features of good design – Important concepts relating to research design.

UNIT II

Implicit functions and extremum problems: Introduction – Functions with non-zero Jacobian determinant – Inverse function theorem – Implicit function theorem – Extrema of real valued functions of one variable and several variables. Rank Theorem – Determinants – Derivatives of Higher order-Differentiation of Integrals.

UNIT III

Oscillations of second order equation-Fundamental results – Sturm's comparison theorem – elementary linear oscillations – comparison theorem of Hill-Winter – Oscillations of $x'' + a(t)x = 0$ elementary non linear oscillations – stability of linear and non linear systems – elementary critical points – system of equations with constant coefficient – the linear equations with constant coefficient – Lyapunov stability – Stability of quasi linear systems.

UNIT IV

LATEX: The Basics - The Document -Bibliography - Bibliographic Databases - Table of contents, Index and Glossary - Displayed Text - Rows and Columns -Typesetting Mathematics - Typesetting - Several Kinds of Boxes - The figure environment -Cross References in LATEX - Footnotes, Marginpars, and Endnotes.

UNIT V

Objectives and role of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecture preparation – Characteristics of instructional design – Method of teaching and learning: Large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing Demonstration, Brain Storing, case discussion and assignment, Methods of evaluation – Self-evaluation, Student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: e-learning researches – web based learning.

SUGGESTED READINGS

1. Kothari C.R., (2014). Research Methodology, Method and Techniques, Second Edition, New age International publishers, New Delhi.
2. Rudin W., (2016). Principles of Mathematical Analysis, McGraw Hill, New York.
3. Earl Coddington A., (2002). An introduction to Ordinary Differential Equations, Prentice Hall of India Private limited, New Delhi. (For Unit III)
4. Krishnan E., (2003). Latex Tutorials – A primer, Indian TEX users group, Trivandrum, India.
5. Panneerselvam R, (2013). Research Methodology, Second Edition, Prentice Hall of India, New Delhi.
6. Gupta S. P, (2011). Statistical Methods, Fourth Edition, Sultan Chand & Sons, New Delhi.
7. Vedanayagam E. G., (2019). Teaching Technology for College teachers, New Delhi.
8. Kumar K. L., (2004). Educational Technologies, New age International, New Delhi.
9. Winkler Anthony C., and Jo Roy McCuen., (2015). Writing a research paper: A Handbook, 2nd edition, Harcourt, New York.

24RMAT201

RESEARCH AND PUBLICATION ETHICS

Paper-II
4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVE:

To make the learners to

- Know about the basic of philosophy of science and ethics, research integrity, publication ethics
- Know about the hands on sessions are designed to identify misconduct and predatory publications.
- Learn indexing and citation databases, open access publication, research and p metrics and plagiarism tools introduced in the course.
- Understand the concept of Group discussions.
- Learn the impact factor of journal as per Journal Citation Report.
- Identify the concept development of e- content.

COURSE OUTCOMES (COs):

Learners able to:

1. Attain mastery in basic concept and moral philosophy of research process.
2. Understand selective reporting and misrepresentation of date.
3. Identify violation of publication ethics, authorship and contributing and appeals.
4. Summarize the philosopher who developed the terms of ethics and their arguments about on ethics.
5. Know about the indexing database and impact factor of journals.
6. Understand the concepts of Learning Management system.

UNIT I PHILOSOPHY AND ETHICS

Introduction to Philosophy: Definition, nature and scope, concept, branches – Ethics: Definition, moral philosophy, nature of moral judgments and reaction.

UNIT II SCIENTIFIC CONDUCT

Ethics with respect to science and research – Intellectual honesty and research integrity – scientific misconduct: Falsification – Fabrication – Fabrication and Plagiarism (FFP) – Redundant publications: duplicate and over lapping publication-salami slicing- selective reporting and misrepresentation of date.

UNIT III PUBLICATION ETHICS

Publication Ethics: Definition, introduction and importance- Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc. – Conflicts of interest – publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, type- violation of publication ethics, authorship and contributing and appeals- predatory publishers and journals.

UNIT IV PUBLICATION MISCONDUCT

Group discussions: Subject specific ethical issues, FFP, authorship – conflicts of interest- complaints and appeals: examples and fraud from India and abroad.

Software Tools: Use of Plagiarism software tools like Turnitin, Urkund and other open source software tools.

UNIT V DATABASE AND RESEARCH METRICS

Database: indexing database- citation database: web of science, scopus, etc.

Research Metrics: impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score – Metrics: h-index, g index, g index, I 10 indices, altmetrics.

UNIT VI DEVELOPMENT OF E- CONTENT & IPR

Integrated Library Management System (ILMS): e-journals – e-books – e-shodhsindu – shodhganga – database – e-content development – Learning Management system (LMS) – e-PG – Pathshala – CEC (UG) SWAYAM – MOOCs – NPTEL – NMEICT.

IPR: Patent – Copyrights- trademark – Geographical Indication.

PRACTICE:

Open access publishing

Open access publications and initiatives-SHERPA/RoMEO online resource to check polisher copyright & self -archiving policies-software tool to identify predatory publications developed by SPPU-Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

24RMAT301

FUZZY MATHEMATICS

Paper-III
4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Study in detail the basic mathematical elements of the theory of fuzzy sets.
- Understand the concepts of operations on fuzzy sets.
- Know about the concepts fuzzy relations and fuzzy graphs.
- Know about the momentous of fuzzy measures and probability measure.
- Solve problems by using the concept decision making in fuzzy environments.
- Know the importance of fuzzy logic in real life problems.

COURSE OUTCOMES (COs):

Learners able to:

1. Understand about the concepts of fuzzy sets and fuzzy logic.
2. Acquire the knowledge on general aggregation operations.
3. Know about the fuzzy relation equation and fuzzy graphs.
4. Describe the probability measures and fuzzy measures of fuzziness.
5. Import the knowledge on the decision making in fuzzy environments.
6. Understand decision making in fuzzy environments.

UNIT I

Crisps sets and Fuzzy sets: Introduction –Crisp Sets: An overview-The notion of fuzzy sets – Basics concepts of fuzzy sets –Classical logic: An overview-Fuzzy logic.

UNIT II

Operations on Fuzzy sets: Fuzzy complement - fuzzy union – fuzzy Intersection – combinations of operation – General Aggregation operations.

UNIT III

Fuzzy relations and Fuzzy graphs: Crisp and fuzzy relations – Binary relations- Binary relations on a single set – Equivalence and similarity relations-Compatibility or Tolerance relations – ordering- Morphisms – Fuzzy relation equations – Fuzzy graphs.

UNIT IV

Fuzzy Measures: Belief and Plausibility Measures – Probability Measures – Possibility and necessity measures-Relationship among classes of Fuzzy measures of Fuzziness.

UNIT V

Decision making in fuzzy environments: Fuzzy Decisions – Fuzzy Linear programming – symmetric Fuzzy LP – Fuzzy LP with crisp objective function – Fuzzy Dynamic Programming-Fuzzy Dynamic with Crisp state Transformation Function- fuzzy multi criteria Analysis– Multi objective Decision Making (MODM) – Multi Attributive Decision making (MADM).

SUGGESTED READINGS

1. George Klir .J and Tina Folger. A., (2015). Fuzzy sets – Uncertainty and information, Prentice – Hall of India Pvt. Ltd. Chapters: I, II, III & IV.
2. Zimmermann H.J., (2007). Fuzzy set theory and its applications, Fourth Edition Springer. Chapter XIV.

24RMAT302

ADVANCED TOPICS IN FLUID DYNAMICS

Paper-III
4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Acquire the knowledge on the properties of two dimensional flow.
- Import knowledge in thermal boundary layer in laminar flow.
- Understand the concept of equation of motion in rotating co-ordinate system.
- Describe the main properties of the electrodynamic systems.
- Introduce the system of magnetohydrodynamics equations and main theorems that follow from the magnetohydrodynamics system.
- Understand the importance of fluid dynamics in diverse real life applications.

COURSE OUTCOMES (COs):

Learners able to:

1. Solve and classify the fluids based on the physical properties of a fluid.
2. Compute correctly the theory of similarity in heat transfer.
3. Understand non dimensional parameters and Ross by number.
4. Explore the properties of magnetic energy and its applications.
5. Analyze magnetohydro dynamic waves and its applications.
6. Assess the various equations for the incompressible MHD.

UNIT I

Steady unidirectional flow – Poiseuille flow – Two-dimensional flow – Paint-Brush model – unsteady unidirectional flow – Flow with circular stream lines – Flow fields in which inertia forces are negligible – Lubrication theory.

UNIT II

Thermal boundary layer in laminar flow: Derivation of the energy equation – Temperature increase through adiabatic compression – Stagnation temperature – Theory of similarity in heat transfer – Exact solutions for the problem of temperature distribution in a viscous flow – Boundary layer simplifications.

UNIT III

Equation of motion in rotating co-ordinate system – Potential vorticity – vorticity equation – Ertel's theorem – Non dimensional parameters – Rossby number – Ekman number – Geostrophic flow – Taylor – Proudman theorem – Taylor column.

UNIT IV

Magnetohydrodynamics: Electrodynamics of moving media – The electromagnetic effects and the magnetic Reynolds number – Alfen’s theorem – The magnetic energy – The mechanical equations – Basic equations for the incompressible MHD – Steady Laminar motion – Hartmann flow.

UNIT V

Magnetohydrodynamic waves – waves in an infinite fluid of infinite electrical conductivity – Alfen’s waves – Magnetohydrodynamic waves in a compressible fluid – Magneto acoustic waves – Slow and Fast waves – Stability – Physical concepts – Linear-Pinch –Kink – Sausage and Flute types of instability – Method of small oscillations – Jeans criterion for gravitational stability.

SUGGESTED READINGS

1. Batchelor G.K., (2002). An Introduction to Fluid Dynamics, Cambridge University Press.
2. Schlichting H., (2003). Boundary – Layer Theory, Springer.
3. Friedlander S., (1980). An Introduction to the Mathematical Theory of Geophysical Fluid Dynamics, Elsevier.
4. Ferraro V.C.A and Plumpton C., (1972). An Introduction to Magneto Fluid Dynamics, Oxford University.

Paper-III

24RMAT303 **HYDRODYNAMIC AND HYDROMAGNETIC STABILITY** 4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Understand the concept of hydrodynamics systems.
- Impart the basic knowledge of Benard problems.
- Attain mastery in the applications of rotation of fluid in stability analysis.
- Get the knowledge of the effect of magnetic field.
- Know about the perturbation techniques for determining the stability of superposed fluids.
- Understand the concept of important instabilities like Rayleigh-Taylor, Kelvin-Helmholtz instability.

COURSE OUTCOMES (COs):

Learners able to:

1. Describe the fundamental principles of the motion of ideal (inviscid) and real (viscous) fluid flows.
2. Apply analytical concepts to analyze a range of two-dimensional engineering fluid flows, with appropriate choice of simplifying assumptions and boundary conditions.
3. Provide the details of the effect of rotations.
4. Examine the properties of magnetic fields and their behavior.
5. Impart knowledge in concepts of instability.
6. Analyze the analytical technique to characterize the hydrodynamic stability.

UNIT I

Introduction: Basic Concepts - Analysis in terms of normal modes - Non-dimensional number.

UNIT II

Benard Problem: Basic hydrodynamic equations. Boussinesq approximation. Perturbation equations. Analysis into normal modes. Principle of exchange of stabilities. Equations governing the marginal state. Exact solution when instability sets in as stationary convection for two free boundaries.

UNIT III

The effect of rotation: The Perturbation equations. Analysis in terms of normal modes. Variation Principle for stationary convection. Solutions when instability sets in as stationary convection for two free boundaries. On the onset of convection as over stability; the solution for the case of two free boundaries.

UNIT IV

The effect of magnetic field: The Perturbation equations. The case when instability sets in as stationary convection; A variational principle. Solutions for stationary convection and for over stability for the case of two free boundaries. The stability of superposed fluids.

UNIT V

(i) **Rayleigh-Taylor instability:** The Perturbation equations. Inviscid case (the case of two uniform fluids of constant density separated by a horizontal boundary, the case of exponentially varying density). Effect of rotation. Effect of vertical magnetic field.

(ii) **The Kelvin-Helmholtz instability:** The perturbation equations, the case of two uniform fluids in relative horizontal motion separated by a horizontal boundary, the effect of rotation, the effect of horizontal magnetic field.

SUGGESTED READINGS

1. Chandrasekhar S., (2081). Hydrodynamic and Hydromagnetic Stability, Dover Publications.
2. Drazin P.G and Reid W.H., (2004). Hydrodynamic Stability, Cambridge University Press.

24RMAT304

QUEUEING THEORY

Paper-III
4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Attain mastery in the basics of Markov Chains.
- Classify queueing models.
- Know about various Markovian queueing systems.
- Analyze multi server queueing models.
- Solve finite input source queues.
- Develop queueing models to analyze computer networks.

COURSE OUTCOMES (COs):

Learners able to:

1. Mastery in concepts of discrete and continuous time Markov Chains
2. Explain single server queues
3. Examine steady state solution of important queues.
4. Investigate multi sever queues solution.
5. Understand input source models.
6. Model real life queueing scenarios into mathematically.

UNIT I

Introduction-Markov Chains- Basic ideas-Classification of states and chains- Sojourn time - Transition density matrix or infinitesimal generator - Limiting behavior: ergodicity - Transient solution -Alternative definition.

UNIT II

Birth-and-Death Processes: Special case: M/M/1 queue -Pure birth process-Yule-Furry process. Queueing Systems: General Concepts: Basic characteristics -The input or arrival pattern of customers -The pattern of service -The number of servers -The capacity of the system - The queue discipline. The Simple M/M/1 Queue: Steady-state solution of M/M/1 - Waiting-time distributions - The output process -Semi-Markov process analysis.

UNIT III

System with Limited Waiting Space: The M/M/1/K Model: Steady-state solution - Expected number in the system L_K - Equivalence of an M/M/1/K model with a two-stage cyclic model - Birth-and-Death Processes: Exponential Models - The M/M/ ∞ Model: Exponential Model with an Infinite Number of Servers.

UNIT IV

The Model M/M/c: Steady-state distribution - Expected number of busy and idle servers - Waiting-time distributions - The output process .The M/M/c/c System: Erlang Loss Model: Erlang loss (blocking) formula: Recursive algorithm -Relation between Erlang's B and C formulas .

UNIT V

Model with Finite Input Source: Steady-state distribution: M/M/c//m ($m > c$). Engset delay model- Engset loss model M/M/c//m/($m > c$) - The model M/M/c//m($m \leq c$).

SUGGESTED READINGS

1. Medhi J., (2003). Stochastic models in Queueing theory, 2e, Academic press.
2. Donald Gross, John Shortle F, James Thompson M , Carl M., and Harris ., (2008). Fundamentals of Queueing theory, Wiley.
3. Narayan Bhat U., (2008). An introduction to Queueing theory: Modelling and Analysis in Applications, Birkhauser Basel.

24RMAT305

ADVANCED GRAPH THEORY

Paper-III
4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Know about the basic concepts and definitions of graph colouring.
- Understand the dual graphs.
- Attain mastery in factorizations and decompositions of graphs.
- Acquire theoretical knowledge in graph domination.
- About the Ramsey numbers.
- Gain applicability of theoretical concepts to address network design problems.

COURSE OUTCOMES (COs):

Learners able to:

1. Express vertex and edge coloring of graphs and apply in real life situations
2. Describe embeddings, dual graphs and Kuratowski's theorem, five color theorem.
3. Illustrate decomposition and labelling of any type of graphs.
4. Calculate domination and independent domination number of a graph.
5. Explain classical Ramsey numbers and generalize the theory of Ramsey.
6. Apply the concept of domination and labeling in recent research areas.

UNIT I COLORING OF GRAPHS

Vertex coloring and upper bounds – Brook's Theorem – Graphs with large chromatic number – Turan's Theorem – Counting proper coloring – Edge coloring – Characterization of line graph

UNIT II DUAL GRAPHS

Embeddings and Euler's Formula – Dual graphs – Kuratowski's Theorem – Five color theorem – Crossing number – Surface of higher genus

UNIT III DECOMPOSITION AND LABELING

Factorizations and Decompositions of graphs- Labeling of Graphs.

UNIT IV DOMINATION

Domination Theory -The Domination number of a graph- Bounds in terms of degree- The Independent Domination number of a graph

UNIT V RAMSEY THEORY

Classical Ramsey numbers- Generalized Ramsey Theory.

SUGGESTED READINGS

1. Chartrand G and Lesniak L., (2016). Graphs and Digraphs, Chapman and Hall/CRC, New York.
2. Douglas B. West., (2002). Introduction to Graph Theory, Prentice Hall of India.
3. Bondy J. A. and Murty U. S. R.,(2008). Graph Theory, Springer.
4. Harary F., (1972). Graph Theory, Addison-Wesley Publication.
5. Deo N., (2016). Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India.

Paper-III

24RMAT306 OSCILLATION THEORY OF DIFFERENTIAL EQUATIONS 4H – 4C

Instruction Hours / week: L: 4

Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners to

- Know about the basic concepts and brief knowledge of standard inequalities.
- Understand the concept of well-posed problems and show their existence and uniqueness of solutions.
- Acquire theoretical knowledge in oscillation theory of differential equations.
- Gain applicability of theoretical concepts to delay and neutral differential equations.
- Study comparison theorems for second-order ordinary differential equations.
- Study different kinds of oscillation criteria and asymptotic behavior of ordinary, delay and neutral differential equations.

COURSE OUTCOMES (COs):

Learners able to:

1. To develop an understanding of the basic concepts of ordinary differential and functional differential equations (ODE and FDE).
2. To apply the knowledge of the ordinary differential and functional differential equations which will enable them to analyze the dynamics of the processes.
3. Explore some of the basic theories of functional differential equations, recognize basic types of FDEs for which exact solutions may be obtained, and apply the corresponding methods of solution.
4. Recognize ODEs and FDEs concepts that are encountered in the real-world problems, understand and be able to communicate the underlying mathematics involved in order to solve the problems using multiple approaches.
5. Import the knowledge of oscillation theory and apply it to the functional differential equations.
6. Students are introduced to modern concepts and methodologies in differential equations, with particular emphasis on the methods that can be used to solve largescale problems.

UNIT I ALGEBRAIC AND INTEGRAL INEQUALITIES

The Theorem of the Arithmetic and Geometric Means - Holder's Inequality – Minkowski's Inequality – The Inequalities of Gronwall and Bellman – Some Generalization of Gronwall and Bellman inequalities.

UNIT II EXISTENCE AND UNIQUENESS OF SOLUTIONS

Introduction – Lipschitz Continuity - Successive Approximations – Picard’s Theorem – Continuation and Dependence on Initial Conditions – Existence of Solutions in the Large.

UNIT III OSCILLATION OF SECOND-ORDER EQUATIONS

Oscillation of Second-Order Equations – Fundamental Results – Sturm’s Comparison Theorem – Elementary Linear Oscillations – Comparison Theorem of Hille-Wintner – Oscillations of $x''(t)+a(t)x=0$.

UNIT IV OSCILLATION OF DELAY DIFFERENTIAL EQUATIONS

Introduction – Equations with Single Delay - Equations with Variable Delay - Equations with Constant Delay - Equations with Several Delays - Equations with Piecewise Delay Constant Argument.

UNIT V OSCILLATION OF NEUTRAL DIFFERENTIAL EQUATIONS

Introduction - Comparison Theorem and Oscillation – Oscillation of Equations with Variable Coefficients – Existence of Non-Oscillating Solutions.

SUGGESTED READINGS

1. Deo S. G., Lakshmikantham V. and Ragavendra V., (1997). Text Book of Ordinary Differential Equations, Tata McGraw Hill Publ. Co. New Delhi.
2. Agarwal R. P., Bohner M. and W-T Li., (2004). Non Oscillation and Oscillation: Theory for Functional Differential Equations, Marcel Dekker Inc., New York, 2004.
3. Gyori I. and Ladas. G., (1991). Oscillation Theory of Delay Differential Equations with Applications, Clarendon Press, Oxford.
4. Bainov D. D. and Mishev D. P., (1991). Oscillation Theory for Neutral Differential Equations with Delay, IOP Publishing Ltd, New York.
5. Erbe L. H., Kong Q. and Zang B. G., (1995). Oscillation Theory for Functional Differential Equations, Marcel Dekker Inc., New York.
6. Hardy G. H., Littlewood J. E. and Polya G., (1934). Inequalities, Cambridge University Press, London.
7. Pachpatte B.G., (1998). Inequalities for Differential and Integral Equations, Academic Press, London.