Ph.D., BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

Curriculum and Syllabus
(2024-2025)

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KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

DEPARTMENT OF BIOTECHNOLOGY

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)
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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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KARPAGAM
ACADEMY OF HIGHER EDUCATION
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Karpagam Academy of Higher Education

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(Accredited with A+ Grade by NAAC in the Second Cycle)
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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-semesterbachelor'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, accreditor 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 and30% 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 out \side 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 fluorimetricassay 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 modulatingeffects on DNA repair, In: Antimutagenes is 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 atleast 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.

TEMPLATE

ANNEXURE I

Specimen of Cover Page and Title Page
<Font Style Times New Roman>

ANTIOXIDANT ACTIVITY OF INDIAN MEDICINAL PLANTS FROM WESTERN GHATS
Font Size 18><1.5 line spacing>

SYNOPSIS
<Font Size 14>

Submitted by
<Font Size 14><Italic>

RAGHAVENDRA S A
<Font Size 16>

in partial fulfilment of the requirements for the award of the degree of
<Font Size 14><Italic><1.5 line spacing>

DOCTOR OF PHILOSOPHY
<Font Size 16>
IN
BIOTECHNOLOGY
<Font Size 14>

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

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
<Font Size 16><1.5 line spacing>

December, 2022
<Font Size 14>

ANTIOXIDANT ACTIVITY OF INDIAN MEDICINAL PLANTS FROM WESTERN GHATS

SYNOPSIS

Submitted by

RAGHAVENDRA S A

in partial fulfilment of the requirements for the

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December, 2022

ANNEXURE II

Specimen of Cover Page and Title Page
<Font Style Times New Roman>

ANTIOXIDANT ACTIVITY OF INDIAN MEDICINAL PLANTS FROM WESTERN GHATS
<Font Size 18><1.5 line spacing>

THESIS
<Font Size 14>

Submitted by
<Font Size 14><Italic>

RAGHAVENDRA S A
<Font Size 16>

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THESIS

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December, 2022

ANNEXURE III

Specimen of Bonafide Certificate
<Font Style Times New Roman>

KARPAGAM ACADEMY OF HIGHER EDUCATION
COIMBATORE-21
<Font Size 16>

BONAFIDE CERTIFICATE
<Font Size 14>

<Font Size 12>

Certified that this Thesis entitled "_____" is the bonafide work of Mr./Ms. _____who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion in this or any other scholar.

<<Signature of the Co Supervisor>>
<<Name>>
CO SUPERVISOR
<<Designation & Address >>
(If applicable)

<<Signature of theSupervisor>>
<<Name>>
SUPERVISOR
<<Designation & Address >>

ANNEXURE IV

Specimen of Declaration

<Font Style Times New Roman>

DECLARATION

<Font Size 16>

<Font Size 12>

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

<Font Style Times New Roman>

CERTIFICATE

<Font Size 16>

<Font Size 12>

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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Phone: 0422 - 2980011- 14 | Email : info@ kahedu.edu.in

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

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* (To be judged based on the DC Meeting, Time line Presentation and Annual Research Congress)	: Good/Satisfactory/Need improvement (Tick whichever is applicable)

Signature of the Research Scholar **Signature of the Research Supervisor**

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

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**

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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 :
    (Attach photocopies of reprints)
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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Phone: 0422 - 2980011- 14 | Email : info@ kahedu.edu.in

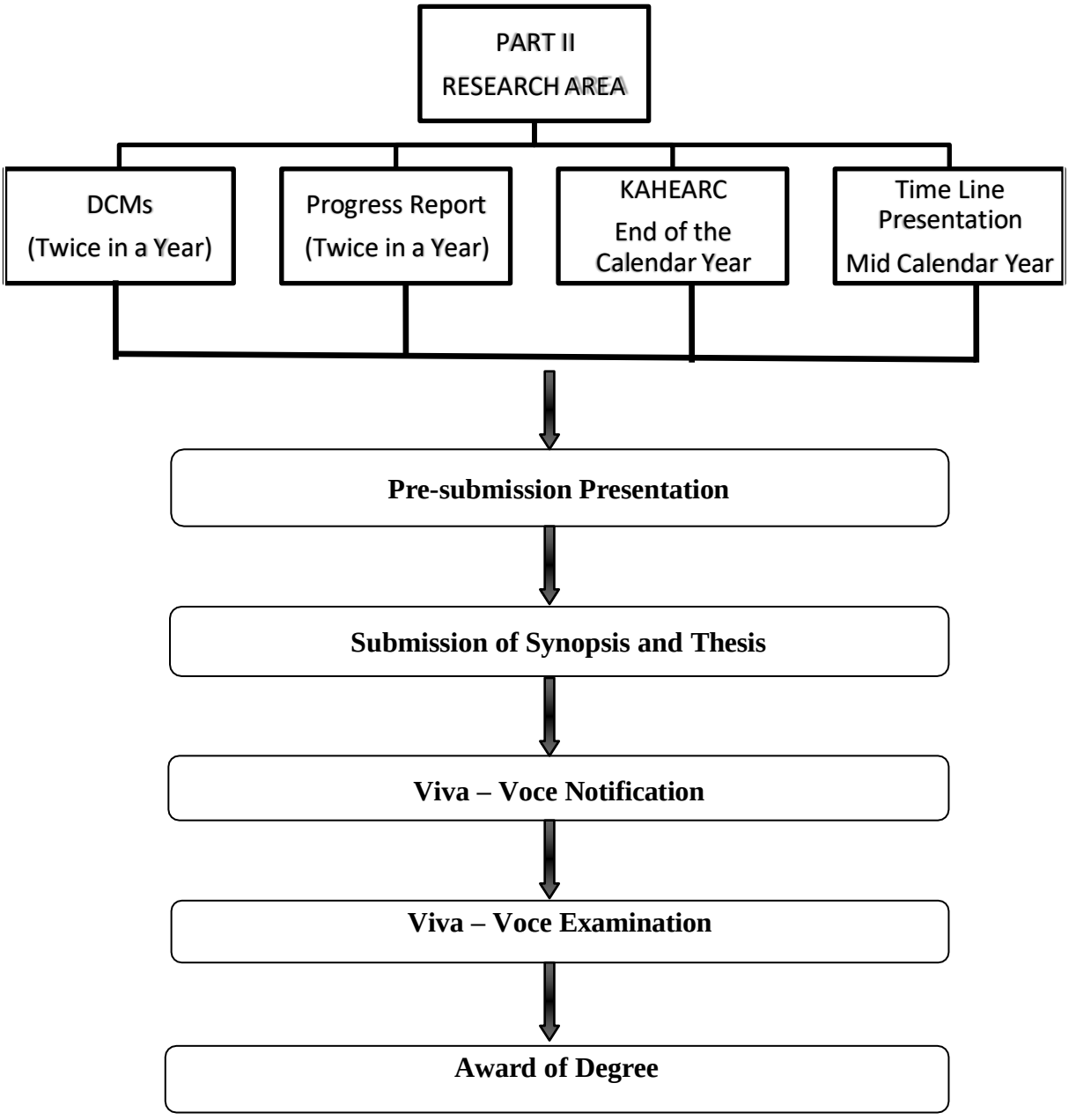
Certificate of Plagiarism

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


PART II
RESEARCH AREA
DCMs
(Twice in a Year)
Progress Report
(Twice in a Year)
KAHEARC
End of the
Calendar Year
Time Line
Presentation
Mid Calendar Year
Pre-submission Presentation
Submission of Synopsis and Thesis
Viva – Voce Notification
Viva – Voce Examination
Award of Degree

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 2008.

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, $\text{Impactfactor (in 2022)} = \frac{A}{B}$

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 BIOTECHNOLOGY
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
RESEARCH PROGRAMME PhD in Biotechnology (2024–2025 Batch and onwards)

Code	Course	Objectives and Outcomes		Ins*	Marks	Exam Hrs	Credit
		PEO´s	PO´s & PSO´s	hours / week	Total		
24RBT101	**Paper – I:** Research Methodology and Pedagogy	I, II,III	a, c, e	4	100	3	4
24RBT201	**Paper – II:** Research Publication Ethics	I,II	b, d	4	100	3	4
Paper – III *				4	100	3	4
24RBT301	Paper – III: Plant Biotechnology	II, III	d, f, g				
24RBT302	Paper – III: Animal Biotechnology	II, III	d, f, g				
24RBT303	Paper – III: Microbial Biotechnology	II, III	d, f, g				
24RBT304	Paper – III: Environmental Biotechnology	II, III	d, f, g				
24RBT305	Paper – III: Structural Biology	III, IV	f, g, h, i				
	Grand total			**12**	**300**	**9**	**12**

PROGRAMME OUTCOMES (POs)

a) Research Graduates will be able to spread over the basic knowledge of applied theories in practical research.

b) Providing necessary broad analytical knowledge to make the scholar for appearing in competitive examinations

c) Ability to design and conduct experiments as well as to interpret the results.

d) A skilled to work on biotechnological concepts and allied fields (immuno, medical, microbial, Food,agricultural, environmental, plants and animals) with recent tools and techniques towards academic, industrial and research application.

e) Scholars will be able to visualize and work on multidisciplinary laboratory problems with standard operating procedures.

f) With professional, societal and ethical responsibilities, the research scholars with be able to identify,formulate and solve to deliver process/product.

g) Research Graduates will be able to update the current knowledge of interdisciplinary subjects of biotechnology.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

To enable the scholar to emerge as:

a) Professional Biotechnologist with lifelong learning with recognized the societal need.

b) Proficient entrepreneurial and leadership qualities with life-long learning.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I: The research graduates of Biotechnology will able to acquire in-depth research knowledge in various fields of Biotechnology and become competent in competitive exams

PEO II: The research graduates of Biotechnology are able to design, analyze, conduct and interpret the experimental data for process/product development in all the areas of biotechnology

PEO III: The research graduates of Biotechnology will able to use the concept of theories, research practical skills and recent technological tools in solving any technological and professional issues independently in a global and societal context

PEO IV: The research graduates of Biotechnology will continue learning to update and to become an entrepreneur in a competitive world of technology and contribute to all forms of life

MAPPING OF PEOs AND POs

PEOs	Programme Outcome (s)						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
PEO I	×	×		`			
PEO II			×	×			
PEO III					×	×	
PEO IV							×

Ph.D **2024-2025**

24RBT101 Paper – I: Research Methodology and Pedagogy 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on Identification of research requirements
- To apply the state of art knowledge for dissertation writing
- To become familiarize with Experiment design
- To understand the methods of data collection and analysis
- To grasp knowledge on Objective and roll of higher education
- The students will learn overall the basic concept in Characteristics of instructional design

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand principles of formulation of objectives and hypothesis	Understand
CO2	Explain Guidelines for review of literature	Understand
CO3	Get insight to Use of software for graphics	Understand
CO4	Students are able to correlate the results using biostatistics tool	Create
CO5	Explain the Ethical issues in animal biotechnology	Remember
CO6	Explain the methods of teaching and learning	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	M	M
CO2	S	S	S	M	M	M	M
CO3	S	S	S	M	M	M	M
CO4	S	S	S	M	M	M	M
CO5	S	S	S	M	M	M	M
CO6	S	S	S	M	M	M	M

S-Strong; M-Medium; L-Low

Unit I Analysis and Identification of research requirements: 8 hours

Prioritization of research area. Review of work done in identified area - time scheduling - laboratory facilities, Research duration –choice of research topic – formulation of objectives- formulation of hypothesis– Methodology – Procedure, experiment design.

Unit II Dissertation writing: **8 hours**

Guidelines for review of literature - Materials and methods, results and discussion. Interpretation of results, presentation of results, summary, presentation of references and appendix.

Unit III Experiment design: **8 hours**

Regarding observation. Types of observation. Laboratory setting sample; Data collection – Presentation of and analysis of collected data. Preparation of result reports and Publication of research findings in prier reviewed journals, impact factor.

Unit IV Methods of data collection and analysis: **8 hours**

Classification and tabulation. Frequency distribution. Measures of central tendency – Mean, median and mode; Measures of dispersion – Standard deviation, standard error, and variance. Correlation and regression – simple correlation, correlation co-efficient, simple and linear regression analysis. Test of significance (F, t test), chi-square test, ANOVA, DMRT, SPSS. Introduction to computer, MS Office. Data handling – Use of software for graphics, slidemaking, scanning gels, photography X-ray photography and autoradiogram perspective.

Unit V Objective and roll of higher education: **8 hours**

Important characteristics of an effective Lecture - Quality teaching and learning – Lecture Preparation - Characteristicsof instructional design – Methods 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. Sandhu,T. (1990). Research Techniques in Biological Sciences. Anmol Publishers, New Delhi.
2. Palanivelu, P. (1999). Analytical Biochemistry and Separation Technique. 3rd Ed, 22st Century Publications, Madurai.
3. Sundar Rao, P.S.S and Richard, J. (2006). Introduction to Biostatistics and Research Methods. PHI Publications, New Delhi.
4. Kothari, C. R. (2004). Research Methodology – Methods and Techniques. 2nd Ed. New Age International Pvt. Ltd, New Delhi.
5. Attwood, T. K. and Parry Smith, D. J. (2002). Introduction to Bioinformatics. Pearson Education Ltd, Singapore.

Ph.D **2024-2025**

24RBT201 **Paper – II: Research Publication Ethics** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on philosophy and ethics
- To apply the state of art knowledge for scientific conduct
- To become familiarize with publication ethics
- To understand the methods of publication misconduct
- To grasp knowledge on database and research metrics
- The students will learn overall open access publishing.

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand principles of philosophy and ethics	Understand
CO2	Explain research Intellectual honesty	Understand
CO3	Get insight to plagiarism	Understand
CO4	Develop the e-content	Create
CO5	Access the Learning Management System	Remember
CO6	Understand publication misconduct	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	M	M
CO2	S	S	S	M	M	M	M
CO3	S	S	S	M	M	M	M
CO4	S	S	S	M	M	M	M
CO5	S	S	S	M	M	M	M
CO6	S	S	S	M	M	M	M

S-Strong; M-Medium; L-Low

Unit I Philosophy and Ethics: **6 hours**

Introduction to Philosophy: definition, nature, scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgment and reactions.

Unit II Scientific Conduct: **6 hours**

Ethics with respect to science and research - Intellectual honesty and research integrity, copyright Scientific

misconduct: falsification, fabrication and Plagiarism (FFP) Redundant Publication: duplication and overlapping publication, salami slicing reporting and misrepresentation of data

Unit III Publication Ethics: **6 hours**

Publication Ethics: definition, introduction and importance, Best practice/standard setting initiative and guidelines: COPE, WAME, etc. Conflict and interest - Publication misconduct: definition, concept, problems that leads to unethical behavior and vice versa, type. Violation of publication ethics, authorship and contributorship Identification of publication misconduct, complaint and appeals. Predatory publisher and journals.

UNIT IV Publication Misconduct: **8 hours**

Group Discussions: Subject Specific Ethical Issues FFP, authorship, Complaints and appeals: examples and fraud, from India and abroad. Software tools: Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

UNIT V Database and research metrics: **7 hours**

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, i-10 index, altmetrics.

UNIT VI: Development of e-content & IPR: **7 hours**

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- Trademarks- Geographical Indications.

PRACTICE

Open access publishing

Open access publication and initiatives - SHERPA/RoMEOonline resource to check publisher copyright and self-archiving policies Software tool to identify predatory publication developed by SPPU - Journal finder/journal suggestion tools viz. JANE, Elsevier Journal finder, Springer, Journal Suggester, etc.

24RBT301 **Paper – III: Plant Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To give students deep knowledge in plant Biotechnology
- To widen the knowledge acquired in other course by handling of classical and modern plant biotechnology
- To know about breeding of healthy plants, plants with improved characteristics
- To produce biomolecules from plants
- To examine the classification of plant species
- To understand the biotechnological processes have also applicative value in pharmaceutical and food industry, in agriculture and in ecology.

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Recall the basic concepts of Biotechnology and explain fundamental cellular events during the process of plant cell culture development	Understand
CO2	Determine the factors influencing plant cell differentiation	Understand
CO3	Execute proper techniques/ procedures for the maintenance of sterile condition and proper plant growth	Understand
CO4	Apply learned techniques in new or similar situations	Create
CO5	Translate the concepts in future studies and evaluate its significances	Remember
CO6	Express the concerns over modern plant biotechnology and analyze them according to the regulatory frame works	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	S	S	S
CO2	M	M	M	S	S	S	S
CO3	M	M	M	S	S	S	S
CO4	M	M	M	S	S	S	S
CO5	M	M	M	S	S	S	S
CO6	M	M	M	S	S	S	S

S-Strong; M-Medium; L-Low

Unit I Plant genetic engineering: **8 hours**

Methodology; Plant transformation with Ti plasmid of *Agrobacterium tumifacians*; Ti plasmid derived vector systems, Ri plasmids; Physical methods of transferring genes to plants - Microprojectile bombardment, Electroporation; Manipulation of gene expression in plants; Production of marker free transgenic plants.

Unit II Biotechnology of medicinal plants: **8 hours**

Production of secondary metabolites from cultured plant cells, elicitation, immobilization, biotransformation, continuous culture and product recovery, DNA bar coding, DNA fingerprinting of medicinal plants- DNA isolation and fingerprinting techniques, Chemical fingerprinting by HPTLC.

Unit III Biotechnological Tools: **8 hours**

UPGMA based analysis – RFLP, RAPD, AFLP, STS, ISSR. Protein and Nucleic acid sequencing and Micro-array. Next generation sequencing approaches. Basic Principles and applications. Bioinstrumentation: Microscopy, Electrophoresis, Centrifugation, ELISA, RIA, FISH. Separation techniques; HPLC, GC, HPTLC, LC-MS and application. Spectrophotometry-UV-VIS, FT-IR, Flame photometry, fluorimetry, Flow cytometry and AAS.

Unit IV Genetic engineering and Biotechnology: **8 hours**

Introduction to plant genetic engineering and biotechnology, gene identification, gene isolation, synthesis of gene and gene cloning, restriction enzymes and vectors, regeneration in crop plants, application of plant genetic engineering and biotechnology, transgenic crops, application of rDNA technology – current status and future prospects, regulation,mechanism for genetically modified crops, biosafety issues of transgenic crops.

Unit V Molecular breeding: **8 hours**

Molecular mapping and tagging of agronomically important traits, QTL analysis in crop plants, marker assisted selection for qualitative and quantitative traits, gene pyramiding, genetic engineering, Application in crop improvement.

SUGGESTED READINGS:

1. Bernald R Glick, and Jack J Paternack (1996), Molecular Biotechnology, Panima Publication, New Delhi.
2. Brown T A (2000) 'Gene Cloning – An Introduction, 3rd Edition, Stanley thrones Publishers Ltd, New York.
3. Chawla, H.S (2018). Introduction to Plant Biotechnology (3rd ed.) . CRC Press, Florida, United States.
4. Halford, N. (2006). Plant Biotechnology: Current and Future Application of Genetically Modified Crops.Wiley-Blackwell, New Jersey, United states.

Ph.D **2024-2025**

24RBT302 **Paper – III: Animal Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on basic animal tissue culture techniques
- To apply the state of art knowledge of subject for the production of tissues, introducing modern drug delivery or vaccination methods
- To become familiarize with the ethical practices in animal biotechnology
- To understand the laboratory design and requirements for animal tissue culture
- To grasp knowledge on molecular techniques in animal cell culture
- The students will learn overall the basic concept in embryology

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand principles of animal culture, media preparation	Understand
CO2	Explain *in-vitro* fertilization and embryo transfer technology	Understand
CO3	Get insight in applications of recombinant DNA technology in improvement of livestock and animal breeding	Understand
CO4	Production of therapeutic proteins in transgenic animals	Create
CO5	Explain the Ethical issues in animal biotechnology	Remember
CO6	Handle and maintain the animal models in animal houses	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	S	S	S
CO2	M	M	M	S	S	S	S
CO3	M	M	M	S	S	S	S
CO4	M	M	M	S	S	S	S
CO5	M	M	M	S	S	S	S
CO6	M	M	M	S	S	S	S

S-Strong; M-Medium; L-Low

Unit I Laboratory design and requirements for animal tissue culture: **8 hours**

Animal tissue culture media, Physical, chemical and metabolic functions of different constituents of serum free culture medium and their

applications. Types of tissue culture; disaggregation of tissue and primary cellculture, established culture, suspension culture, organ culture, three-dimensional culture.

Unit II Cell separation: **8 hours**

Cell counting Cell synchronization. cryopreservation. Cell lines - cell banks. Tissue engineering. Biology and characterization of cultured cells, tissue typing; cell – cell interaction; measuring parameters of growth; measurement of cell death – apoptosis and its determination; cytotoxicity assays.

Unit III Characterization: **8 hours**

Need for characterization, Morphology, Chromosome analysis, DNA, RNA, Protein, Enzyme and Antigenic Markers. Lymphocyte preparation, Somatic cell fusion.

Unit IV Molecular cell techniques in cell culture: **8 hours**

Cell transformation- physical, chemical and biological methods; manipulation of genes; cell cloning and micro manipulation; hybridoma technology and its applications; gene targeting. Gene Therapy. Green fluorescent protein and its applications, Oncogenes and tumor suppressor genes and their regulation.

Unit V Embryology: **8 hours**

Collection and preservation of embryos; culturing of embryos; gametogenesis and fertilization in animals; types ofcleavage pattern. *In vitro* fertilization and stem cell research. Transgenesis: Transgenic animals; production and application; transgenic animals as models for human diseases, transgenic in industry; Vaccine production. Ethical issues in animal biotechnology.

SUGGESTED READINGS:

1. Freshney, R.I. (2000). Culture of Animal cell: A practical approach, 4th Edition, John Wiley Publications,New York.
2. Jennie, P. Mather and David Barnes. (2001). Methods in Cell Biology. Academic Press, New York.
3. Primrose, S. B., Twyman, R. M. and Old, R. W. (2001). 6th Ed, Principles of Gene Manipulation. BlackwellScience Publishing Company, Germany.
4. Ranga, M. M. (2003). Animal Biotechnology. 2nd Edition, Agrobios (India), Jodhpur.

Ph.D **2024-2025**

24RBT303 **Paper – III: Microbial Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To provide an in-depth look at how microbes and their metabolic pathways and products can be used in biotechnology
- To develop their own interests in other aspects of biotechnology
- To acquire knowledge on the use of genetically manipulated organisms, biotechnologically important enzymes and specific biochemical pathway
- To understand the microbial bio-conservation rate in yield of agriculture
- To describe the waste utilization of sewage
- To know the industrial applications of algal biomass

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Critically evaluate the role of micro-organisms in specific biotechnological processes.	Understand
CO2	Explain the complex processes behind the development of genetically manipulated organisms.	Understand
CO3	Demonstrate a clear understanding of how biochemical pathways relate to biotechnological applications.	Understand
CO4	Discuss state-of-the-art technologies of genetics of antimicrobial metabolite production in biocontrol bacteria.	Create
CO5	Identify microbiological techniques, the defining characteristics of the major groups of microorganisms andapply to study microbial phylogeny	Remember
CO6	Collect the proficient knowledge of living systems in the energy production, utilization of waste to commercially important compounds and bioremediation process	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	S	S	S
CO2	M	M	M	S	S	S	S
CO3	M	M	M	S	S	S	S
CO4	M	M	M	S	S	S	S
CO5	M	M	M	S	S	S	S
CO6	M	M	M	S	S	S	S

S-Strong; M-Medium; L-Low

UNIT I Introduction: **8 hours**

General concepts of microbial biotechnology. Microorganisms as factories for the production of novel compounds.Genetic engineering of microbes to improve production of antibiotics and secondary metabolites. Biopolymers andbioplastics. Preservation and improvement of Industrially important microorganisms, Strain development by Mutagenesis, Protoplast fusion and Genetic engineering.

UNIT II Microalgae and Fungai: **8 hours**

History and biotechnological potentials of microalgae, food, feed. Colorant, fuel and pharmaceutically valuable compounds. Cultivation methods of algae with reference to *Dunaliella sp.* and *Phormidium valderianum,* Characteristics of Single-cell Biomass composition; Nutritional Value and Toxicological Status; Types of fermentationsystem for biomass production. Baker's yeast; Production of probiotic biomass; and mold cultures. Application ofmicroalgae in industries.

UNIT III Agricultural Microbiology: **8 hours**

Plant Microbes Interaction; Microbial herbicides, Agricultural antibiotics, Microbial Bio-fertilizers and Bio- insecticides; Biological pest control. Mode of action of biological control involved in different biocontrol agents. Genetics of antimicrobial metabolite production in biocontrol bacteria. Potential impacts on the environment and human health.

UNIT IV Microbial Bioconversion: **8 hours**

Bioconversion of cellulosic and non-cellulosic wastes. Mechanism of novel carboxylase genes involved in bioconversion. Agro byproducts. Bioremediation of wood, fuels lubricants, rubber and plastics. Bioremediation in paper and pulp industries; Aerobic and anaerobic digester: Design; various types of digester for bioremediation in Industrial effluents. Production of citric acid using sucrose and molasses; Production of extracellular enzymes; Ethanol production using immobilized yeast culture.

UNIT V Waste utilization: **8 hours**

Biogas production, Waste water treatment - Aerobic and Anaerobic processes, Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Sewage disposal, compost making, green manuring, Microbialproducts and plant health, methane generation. Microbiology of degradation of xenobiotics in environment.

SUGGESTED READINGS:

1. Bernad. R. Glick and Jack J. Pasternak. (2002). Molecular Biotechnology Principles and Applications ofRecombinant DNA. WCB.
2. Glazer, A.N. and Nikaido, H. (2007) Microbial Biotechnology. Cambridge, New York.
3. Harzevili, D.F. and Chen, H. (2015). Microbial Biotechonology: Progress and trends. Taylor and Francisgroup.
4. Kun, Y.L (2013). Microbial Biotechnology: Principles and applications. World Scientific PublishingCompany; 3rd revised ed. Edition.

Ph.D **2024-2025**

24RBT304 **Paper – III: Environmental Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain basic concepts of biotechnology to solve the environmental pollution problems
- To ascertain the knowledge about solid waste management and wastewater treatment.
- To gain information about Environmental nanotechnology.
- To gain knowledge about the biological and biotechnological measures for restoringenvironment.
- To involve in the present scenarios and find valuable solutions for remedy
- To update about the management strategies followed up by the industries and government

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Water Pollution Monitoring	Understand
CO2	Pollution and pollution control	Understand
CO3	Environmental significance of genetically modified microbes, plants and animals	Understand
CO4	Solid waste management systems	Create
CO5	Treatment of municipal waste and Industrial effluents	Remember
CO6	Biotechnologically important intracellular products	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	S	S	S
CO2	M	M	M	S	S	S	S
CO3	M	M	M	S	S	S	S
CO4	M	M	M	S	S	S	S
CO5	M	M	M	S	S	S	S
CO6	M	M	M	S	S	S	S

S-Strong; M-Medium; L-Low

Unit I Environmental pollution: **8 hours**

Concept of Environmental Pollution; Origin of pollution; Classification and nature of Environmental Pollutants; Majorsources; Environmental Pollution at local regional and global level. Environmental Quality Assessment and Monitoring, Deterioration of environmental quality with reference to anthropogenic impact; Environmental ImpactAssessment (EIA).

Unit II Water pollution monitoring: **8 hours**

Pollutant analysis in water – Physiochemical parameters, Microbiological examination, APDC and MIBK analyses.Methods of monitoring; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Strategies for controlling pathogen transfer; Chemicalmethods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors to monitor pollution.

Unit III Effluent treatment and solid waste management systems: **8 hours**

Sewage and waste water treatments systems; Primary, secondary and tertiary treatments- Phytoremediation; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments; Environmentalpollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments; Reactors types and design; Solid waste management – types of solid waste; Disposal methods – Sanitary, incineration, land-fill, composting, vermicomposting; recovery of energy from solid waste.

Unit IV Environmental Nanotechnology: **8 hours**

Techniques for synthesis of nanomaterials and nanocomposite; mobility of nanomaterials in aqueous environments, surface chemistry of mineral oxide and carbon nanoparticles, development of nanostructured membranes, mechanisms of nanoparticle bio- degradation, development of nanostructured ceramic bodies for environmental separations and catalysis, nanomaterial-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation.

Unit V Environmental Microbiology: **8 hours**

Microbes in the environment, measurement of bacterial growth, collection and processing of environmental samples. Media Formulation; Sterilization; Thermal death kinetics Primary and secondary metabolites; Extracellular enzymes; biotechnologically important intracellular products; exopolymers; biopolymer production.

SUGGESTED READINGS:

1. Agarval, S. K (2002). Environmental Biotechnology. APH Publishing Corporation, New Delhi.
2. Alans Scragg (2005). *Environmental Biotechnology*. Oxford University Press. Inc. New York.
3. Bailey J E and D F Ollis (1986). Biochemical Engineering fundamentals. 2nd Ed. Chapters 13 & 14,McGraw – Hill.
4. Charles P Poole Jr., Frank J Owens. (2007). Introduction to Nanotechnology. John Wiley & sons Asia Pvt.Ltd. New Delhi.
5. Mark J Hammer (2000). Water and Waste Water Technology. 4th Edition, Prentice Hall of India Pvt Ltd, NewDelhi.
6. Singh, M. P., Soma Dey and Bijay S Singh. (2004). Conservation of Biodiversity and Natural Resources.Daya Publishing House, New Delhi.
7. Yadav, P. R and Shubhrata R Mishra. (2004). Environmental Biodiversity. Discovery Publishing House, NewDelhi.

24RBT305 **Paper – III: Structural Biology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks**: **Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- Understand fundamental principles of Stereochemical analysis of proteins
- Comprehend the optical activities of biological macromolecules.
- Recognize the concepts on Structural characterizations of proteins
- Obtain key knowledge on Molecular Modeling methods
- Understand key concepts on NMR structures of proteins – Calculations and validations.
- Attain strong knowledge on Computational Methods in Structural Biology

Course Outcomes

On successful completion of the course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Demonstrate an understanding the detection methods for enzyme kinetics	Understand
CO2	Identify, explain and judge safety issues related to biomedical instrumentation	Understand
CO3	Apply the principles in analyzing structural interactions and structural transitions	Understand
CO4	Define the principal concepts about Proteins in solution state	Create
CO5	Recognize the definition of protein crystallography and related concepts	Remember
CO6	Apply the Phylogenetics in Structural Biology	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	S	S	S
CO2	M	M	M	S	S	S	S
CO3	M	M	M	S	S	S	S
CO4	M	M	M	S	S	S	S
CO5	M	M	M	S	S	S	S
CO6	M	M	M	S	S	S	S

S-Strong; M-Medium; L-Low

Unit I Biomolecular Chemistry: **8 hours**

Electronic configurations – Quantum numbers – Chemical bondings – Isomerisms – Buffers in biological systems –Stereochemical analysis of proteins – Protein folding and biological significance – Thermodynamic estimation of protein stability – Biological functions – Allosteric effect - Detection methods for enzyme kinetics – DNA structures –Types – Helical transitions – *Syn/Anti* conformations - Sugar puckering –Optical activities of biological macromolecules.

Unit II Structural Characterizations of Biomolecules: **8 hours**

Analyzing structural interactions and structural transitions of biological macromolecules under thermodynamic and as well kinetic environments through advanced techniques – SF-Ultraviolet spectroscopy - SF-Fluorescence spectroscopy- SF-Circular Dichroism spectroscopy - QF-Nuclear Magnetic Resonance techniques in conjunction with Hydrogen- Deuterium exchange (EX1/EX2) methods.

Unit III NMR of Proteins: **8 hours**

Proteins in solution state - Basic principles of NMR - Chemical shift - Inductive effects - Anisotropic effects - Spin-spin splitting - Double resonance method - Structural characterizations of proteins by 1D NMR methods - 2D NMR experiments: COSY, TOCSY, NOESY - Assignment strategies - 3D NMR experiments (HNCA, HNCOCA, HNCACB, CBCACONH, CCH-TOCSY, HCCH-TOCSY) – NMR structures of proteins – Calculations and validations.

Unit IV Structures of Proteins in Solid and Gaseous states: **8 hours**

Mass spectrometry – Basic principles – EI-MS of small molecules - Structural characterizations and folding pathways of proteins by ESI-MS and MALDI-MS - Structures of proteins in gaseous state by IM-MS - Protein crystallography -Bragg's law - Space groups - Miller indices - Collecting X-ray data - Unit cell determination - Matthew's coefficient -Phase problem - Obtaining Model Structures.

Unit V Computational Methods in Structural Biology: **8 hours**

Local and global sequence alignment algorithms - Multiple-sequence alignment strategies – Phylogenetics – MolecularModelling methods - Classification of proteins using CATH & SCOP - Process of drug discovery - Structure-based lead design – Ligand-based lead design – Molecular docking – HTVS - Small molecular libraries – Pharmacophores -QSAR methods - Lead optimization – ADMET.

SUGGESTED READINGS

1. David W.M. (2005). Bioinformatics – Sequence and Genome Analysis. (CSHL Press).
2. Freeman WH (1999). Structure and mechanism in protein science.
3. Keith W and John MW. (2010). Principles and Techniques of Biochemistry and Molecular Biology(Cambridge University Press).
4. Kurt W (1986). NMR of proteins and nucleic acids (Wiley, New York).
5. Morrison RT, Boyd RN and Bhattacharjee SK. (2011). Organic Chemistry (Pearson India).
6. Rodwell VW, Bender D, Botham KM, Kennelly PJ and Weil PA. (2015). Harper's Illustrated Biochemistry(McGraw-Hill Medical).
7. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2013). Molecular Biology of the Gene(Benjamin Cummings).