FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY

IN

BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM

(2024 - 2025)

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

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

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

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

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FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.)

REGULATIONS
(2024)

CHOICE BASED CREDIT SYSTEM

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
(Deemed to be University)
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Karpagam Academy of Higher Education

(Deemed to be University)
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Pollachi Main Road, Eachanari Post, Coimbatore – 641 021, Tamil Nadu, India
info@kahedu.edu.in; kuresearch@kahedu.edu.in
www.kahedu.edu.in

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

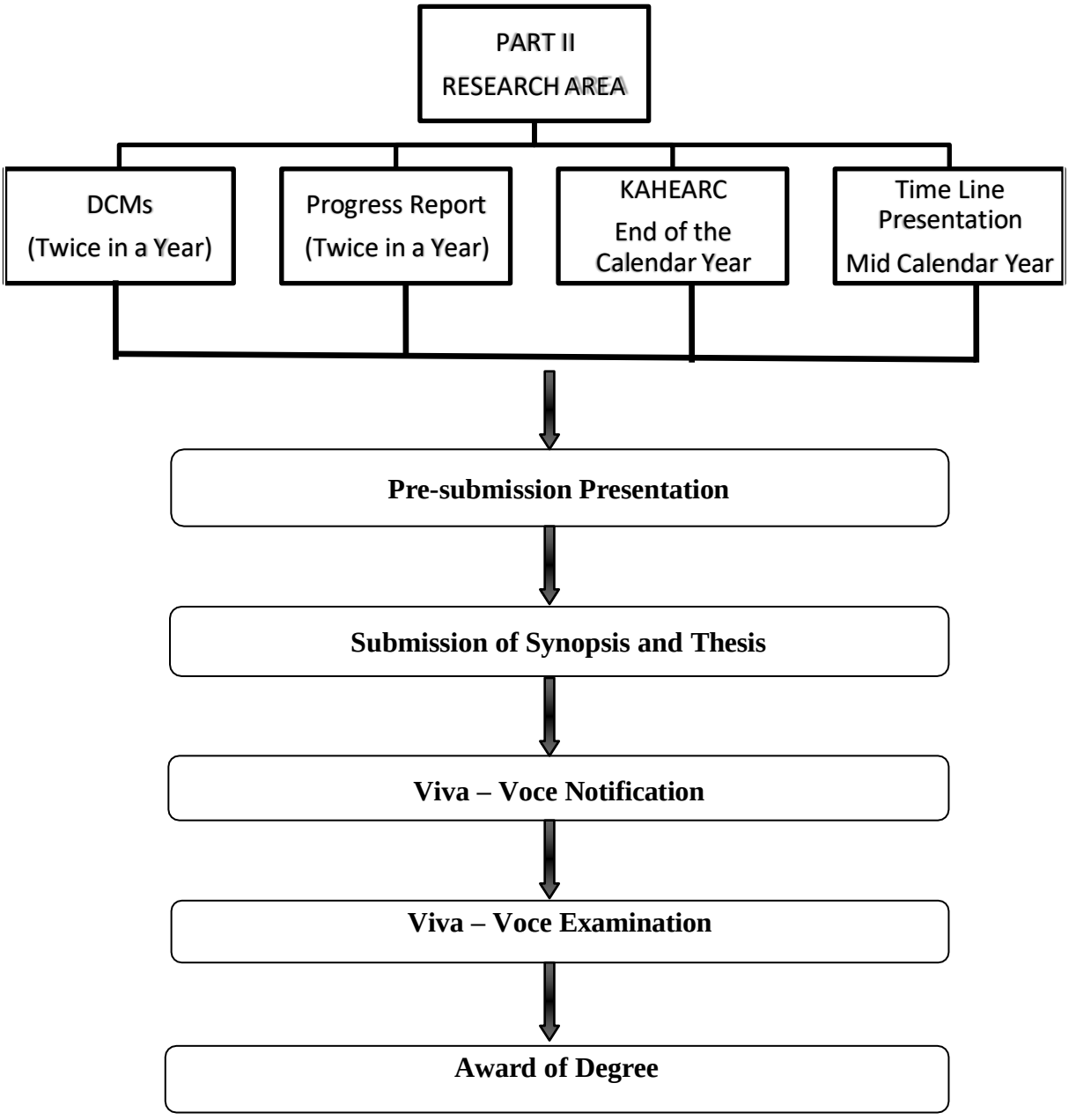
Certificate of Plagiarism

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.

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PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN BIOTECHNOLOGY (2024-2025)

SL.NO	TITLE OF THE COURSE	NO. OF SUBJECT	CREDIT	EXAM. HRS	MARKS
1	PAPER I	01	4	3	100
2	PAPER II	01	4	3	100
3	PAPER III	01	4	3	100
	TOTAL	03	12	9	300

PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN BIOTECHNOLOGY (2023-2024)

SUB.CODE	TITLE OF THE COURSE	CREDITS	EXAM HRS	MARKS
PAPER - I (COMPULSORY)				
24RBTE101	Research Methodology and Pedagogy	4	3	100
PAPER - II (COMPULSORY)				
24RBTE201	Research and Publication Ethics	4	3	100
PAPER - III (ANY ONE)				
24RBTE301	Microbial Genetics	4	3	100
24RBTE302	Bioprocess Modelling and Simulation	4	3	100
24RBTE303	Molecular Modelling and Drug Designing	4	3	100
24RBTE304	Industrial Nanotechnology	4	3	100
24RBTE305	Clinical Biochemistry	4	3	100
24RBTE306	Bioreactor Design and Analysis	4	3	100
24RBTE307	Advanced Systems Biology	4	3	100
24RBTE308	Advances in Cancer Biology	4	3	100
24RBTE309	Advanced Drug Delivery Systems	4	3	100

24RBTE101 Research Methodology and Pedagogy 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

UNIT – I

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Concept of design Thinking-Need for theoretical frame work –Research Strategies – Ethics – code of conduct for research – Health and Safety - IPR.

UNIT – II

Research Events – Networks – Outreach Activities – Best Research Practices – Quality Assurance for Research – Journal Critiques - Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

UNIT – III

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

UNIT – IV

Introduction to Statistics – Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes - t-Test –ANOVA- Standard deviation - Co-efficient of variations. Co-relation and Regression Analysis. Purpose of the written report - Concept of audience - Basics of written reports. Research Report: Types of reports- contents - styles of reporting - steps in drafting reports - editing the final draft - Evaluating the final draft.

UNIT – V

Objectives and roll of higher education – important characteristics of an effective lecture – Quality teaching and learning – lecture preparation – characteristics of instructional design – Methods of teaching and learning : large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing demonstration, Brain Storming, Case Discussion, 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. Cooper, D. R., Schindler, P. S., & Sun, J. (2006). Business research methods (Vol. 9). New York: McGraw-Hill Irwin.
2. Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.
3. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
4. McBurney, D. H., & White, T. L. (2009). Research methods. Cengage Learning.
5. Ticehurst, G.W. & Veal, A.J. (2000). Business Research Methods, Managerial approach. Pearson Education.
6. Kumar Ranjit. (2005). Research Methodology. 2nd Edition. Pearson Education.
7. Thietart, R. A. (2001). Doing management research: a comprehensive guide. Sage.

24RBTE201 **Research and Publication Ethics** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I PHILOSOPHY AND ETHICS

Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and relations.

UNIT II SCIENTIFIC CONDUCT

Ethics with respect to science and research - Intellectual honest and research integrity – Scientific misconducts: falsification, fabrication, and plagiarism - Redundant publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data.

UNIT III PUBLICATION ETHICS

Publication ethics: definition, introduction and importance - Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publishers and journals- Reference management tools-Endnote and Mendeleys.

UNIT IV PUBLICATION MISCONDUCT

Group Discussions: Subject specific ethical issues, FFP, authorship - Conflicts of interest - Complaints and appeals: examples and fraud from India and abroad Software tools - Use of plagiarism software like Turnitin, Urkund and other open source software tools.

UNIT V - DATABASES AND RESEARCH METRICS

Databases: Indexing databases - Citation databases: 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, i10 index, altmetrics

UNIT VI DEVELOPMENT OF E-CONTENT & IPR

Integrated Library Management System (ILMS): e-journals – e-books – e-sjodhsindu – shodhganga – Database – e-content development – Learning Management System (LMS) – ePG Pathshala – CEC (UG) SWAYAM – MOOCs – NPTEL – NMEICT. IPR: Patent – copyrights – Trademark – Geographical Indication.

PRACTICE

Open Access Publishing

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

SUGGESTED READINGS:

1. Sengupta, S., & Honavar, S. G. (2017). Publication ethics. Indian journal of ophthalmology, 65(6), 429-432.
2. Singhal, S., & Kalra, B. S. (2021). Publication ethics: Role and responsibility of authors. Indian Journal of Gastroenterology, 40, 65-71.
3. Benos, D. J., Fabres, J., Farmer, J., Gutierrez, J. P., Hennessy, K., Kosek, D., ... & Wang, K. (2005). Ethics and scientific publication. Advances in physiology education, 29(2), 59-74.

24RBTE301 **Microbial Genetics** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Definition and scope of Genetics. Premendelian genetic concepts – Preformationism, Epigenesis, Inheritance of acquired characters, traits, Germplasm theory. Hereditary and Environment, Genotype and Phenotype.

UNIT II

Phage genetics: lytic and lysogenic switch; Virulent and temperate phage. Transduction: Generalized and specialized transduction; gene mapping by specialized transduction, mechanism of generalized transduction, abortive transduction; Transposons - prokaryotic and eukaryotic (yeast, maize, fruit fly).

UNIT III

Fungal Genetics- Features and consequences of heterothallism, homothallism, mating types, Vegetative incompatibility, Polyploidy and aneuploidy. Neurospora- Tetrad analysis and linkage detection - 2 point and 3 point crosses – Induction of Mutations - Mitotic 12 recombination in Neurospora, Gene conversion. Yeast plasmids, Mating type genetics of yeast.

UNIT IV

Bacterial Genetics- Organization of genetic material in bacteria, Gene transfer mechanismsConjugation, Transformation and Transduction. Recombination in bacteria. Natural transformation systems- Streptococcus pneumoniae and Haemophilus influenzae. Transfection and forced competence. Bacterial Conjugation- Properties of the F plasmid, Transduction- Generalized and specialized transduction, Drug resistance in bacteria.

UNIT V

Mechanism of microbial pathogenesis (bacteria, virus, yeast, parasites), genetics of pathogenicity, and virulence. Colonization, Association, Adhesion, and Invasion of host tissue. Alteration of host cell behavior by pathogens, pathogen-induced diseases: bacterial (Vibrio, Tuberculosis, Helicobactor, Salmonella, Streptococcus, Pneumococcus, Clostridium), Viral (Hepatitis, HIV, Influenza, Coronavirus and other emerging viruses oncogenic viruses). Hospital-acquired infections; Pathogenic fungi; Pathogenicity of parasites (Plasmodium, Entamoeba, Naegleria, Leishmania, Trypanosoma), mode of action, virulence, Pathogenicity islands.

SUGGESTED READINGS:

1. Snyder L. and Champness W. (2007). Molecular Genetics of Bacteria. 3rd edition, ASM Press, Washington, D.C.

2. Baumberg. S. (2002). Prokaryotic gene expression. Oxford University Press, UK.

3. Hartl D. L. (2009). Essential Genetics- A genomics perspective, 5th edition, Jones and Barlett Publishers, Boston.

4. Dale J. W. and Park S. F. (2010). Molecular Genetics of Bacteria, Wiley Blackwell Publishers, Boston.

5. Trun N. and Trempy J. (2003). Fundamental Bacterial Genetics. 1st Edition, WileyBlackwell Publishers.

6. Maloy S. R., Cronan J.E., Freifelder D. (1994). Microbial Genetics. Jones and Barlett Publishers, Boston.

24RBTE302 Bioprocess Modelling and Simulation 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

UNIT I

Modelling Principles, model development from first principles. Modelling approaches for Biological systems – structured and unstructured systems; Compartment models; Deterministic and stochastic approaches for modelling structured systems.

UNIT II

External mass transfer, Internal diffusion and reaction within biocatalysts, derivation of finite model for diffusion-reaction systems, dimensionless parameters from diffusion-reaction models, the effectiveness factor concept, case studies; oxygen diffusion effects in a biofilm, biofilm nitrification

UNIT III

Bioreactor modelling: Ideal and non-ideal bioreactors; Stirred tank models; characterization of mass and energy transfer distributions in stirred tanks, Tower Reactor Model; Flow modelling, bubble column flow models, mass transfer modelling, structured models for mass transfer in tower reactors, process models in tower reactors, airlift models,

UNIT IV

Study of linear systems, linearization of non-linear systems; Simulation of linear models using MATLAB; Parameter estimation and sensitivity analysis; Steady state and unsteady state systems; stability analysis; Case study of recombinant protein production.

UNIT V

Advanced modelling techniques such as fuzzy logic, neural network, hybrid systems and fuzzy logic systems; case studies.

SUGGESTED READINGS:

1. Bequette, B. W. (2098). 'Process Dynamics: Modelling, Analysis and Simulation'. Prentice-Hall.
2. Elnashaie, S. S., & Garhyan, P. (2003). Conservation equations and modelling of chemical and biochemical processes. CRC Press.
3. Dunn, I. J. (2005). 'Biological Reaction Engineering: Dynamic Modelling Fundamentals with Simulation'. Wiley-VCH.

24RBTE303 **Molecular Modelling and Drug Designing** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT-1

Molecular mechanics, Energy minimization, intra molecular interactions, Physicochemical parameters in drug design Ionization constants, chelation, solubility and partition Co- efficient. Over view of Molecular Descriptors.

UNIT-II

Introduction to molecular Simulation Techniques-Monte Carlo Methods-Metropolis Monte Carlo Algorithm, Flow calculations in Metropolis Monte Carlo Algorithm with examples- Ising Lattice, Gibbs Ensemble Monte Carlo Simulations. Molecular Dynamics Methods-different methods for the integration of Dynamical Equations, Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles, Structural information from M.D.

UNIT-III

Rational basis of drug designing, criteria for synthesizing drugs, Drug designing approaches-Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction, Structure based drug design process of Structure based design, Receptor based design-drug designing using known receptor structure, design of energy inhibitors.

UNIT-IV

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools, scoring and Docking mode, QSAR principles and Methods in drug designing. Current research in drug designing- a case study.

UNIT – V

Molecular Modelling in drug design: A Case study - Antiviral and Anticancer drug discovery, Recent Advances in the molecular simulation of Drug discovery process, molecular dynamics in personalized medicines.

SUGGESTED READINGS:

1. Leach, A. R. (2001). Molecular Modelling, Principles and application. 2nd Edition. Prentice Hall.

2. Krogsgaard, L. (2002). Text Book of Drug Design and Discovery. Taylor & Francis, London.
3. Walsh, G. (2003). Biopharmaceuticals-Biochemistry and Biotechnology. Wiley.
4. Scolnick, J. (2001). Drug Discovery and Design. Academic Press, London.
5. Cohen, N. C. (2016). Guidebook on Molecular Modelling in Drug Design. 1st Edition. Academic Press, San Diego.

24RBTE304 **Industrial Nanobiotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nano-biotechnology and Nanoscale processes; Challenges and opportunities with biology on nanoscale; Nano-biotechnology systems. Characterization techniques for biological molecular nanostructures, Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging, Dynamic light scattering; Imaging of bio-nanostructures, OCT, MRI, X-ray, CT, PET, Confocal and SPECT.

UNIT II

Agricultureindustry: - Precision farming, Smart delivery system – Insecticides using Nanotechnology – Nanofertilizers -Nanofertigation - Nano-seed Science. Food industry: Nanopackaging for enhanced shelf life - Smart/Intelligent packaging - Food processing and food safety and bio-security –Electrochemical sensors for food analysis and contaminant detection.

UNIT III

Nanotechnology in Textiles and Cosmetics Industries: Textiles Industry: Production of Nano-woven fibers from electrospinning – Controlling parameters and morphologies of nanofibers – Nanocomposite fibers; Bionics: Swim-suits with shark-skin effect, Soil repellence, Lotus effect;Nano finishing in textiles: UV resistant, anti-bacterial, hydrophilic, selfcleaning, flame retardant finishes; Modern textiles: Lightweight bulletproof vests and shirts, Colour changing property, Waterproof and Germ proof clothes. Cosmetics Industry: Formulation of Gels, Shampoos, Hair-conditioners (Micellar self-assembly and its manipulation) – Sun-screen dispersions for UV protection using titanium oxide – Anti-aging cream -Colour cosmetics.

UNIT IV

Nanocatalysts – Smart Materials – Nanostructures for molecular recognition (0D, 1D and 2D) – Molecular encapsulation and its applications – Nanoporous Zeolites – Nano-reactors – Solid lubricants – Nanotechnology in Electrometallurgy, Electroplating industry and Corrosion protective organic coatings – Electrolytic production of metal nanopowders, Electrochemical exfoliation for the production of Graphene and other metal chalcogenides – Electrochemical preparation of Nanostructured conducting polymers.

UNIT V

Overview of physical, chemical and biological processes concerning the environment- Nanomaterial based adsorbents and photocatalysts for water and waste water treatment – Nanomaterials for adsorption of heavy metals – Nanoparticles for degradation of organic and organic compounds – Treatment of Arsenic using Nano TiO2 and other nanoparticles – Nanomembranes in drinking water purification and desalination – Environmental impacts of Nanomaterials on human and animal health – Safety issues and regulatory practices in handling Nanomaterials – Environmental hazard in processing of Nanomaterials – Emerging issues of nano/microplastics - Green synthesis/zero-waste processes

SUGGESTED READINGS:

1. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006.
2. J. Altmann, Routledge, Military Nanotechnology: Potential Applications and Preventive Arms Control, Taylor and Francis Group, 2006.
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006).
4. Lynn J. Frewer, WillehmNorde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011).
5. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).
6. Q. Chaudry, L.Castle and R. Watkins Nanotechnologies in Food, RSC Publications, 2010.
7. W.N.Chang, Nanofibers Fabrication, Performance and Applications, Nova Science Publishers Inc., (2009).

24RBTE305 **Clinical Biochemistry** **4H-**

4C Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100**

Total: 100

End Semester Exam: 3 Hours

UNIT I

Structure and function of biomolecules (carbohydrates, proteins, lipids, nucleic acid, vitamins); energetics and regulations of glycolysis, Krebs cycle, HMP shunt, glycogenesis and glycogenolysis, transamination and deamination, urea cycle, fatty acid synthesis and oxidations, de novo and salvage synthesis and metabolism of purines and pyrimidines, vitamins and minerals roles; disease and inborn error associated with the biomolecule metabolism; enzymes and enzyme kinetics.

UNIT II

Liver function test; kidney function test; pancreas function test; thyroid function test; cardiac function test Cell signaling: Endocrine system and hormone; hormones receptors, cell surface receptor cellular signaling, signal transduction pathways; G-Protein Coupled Receptors, Receptor Tyrosine Kinases, G protein, ras and rho family signaling; primary messenger and secondary messenger.

UNIT III

Inborn errors of amino acid metabolism – Phenylketonuria, alkaptonuria, Hartnup's maplesyrup urine disease, Plasma proteins in health and changes in diseases; paraproteinaemias; proteinuria. Lipid metabolism: Plasma lipids and lipoproteins and their functions. Hyperlipoproteincmias; Classification – primary and secondary. Investigation of lipoproteinemias and lipidemias. Renal function: Glomerular and tubular functions. Tests for evaluation – concentration, dilution, excretion, clearance tests, nephritic syndrome.

UNIT IV

Clinical Enzymology: Plasma enzyme in diagnosis and prognosis – aminotransferases, creatine kinase, LDH, alpha amylase, phosphatases, choline esterase, glucose 6-phosphate dehydrogenase, Gama glutamyl transferase. Isozymes of LDH alkaline phosphatase. Clinical application of plasma enzyme assays in myocardial infraction, liver disease, and muscle disease.

UNIT V

Disorders of Gastrointestinal Tract: Gastric function. Stimulation of gastric secretion. Composition of gastric secretion. Test for gastric function – fractional test meal. Pentagastrin test, insulin stimulation tests; hyperchlorohydria, achlorohydria, achyliagastrica. Pancreatic exocrine secretion – composition.Duodenal contents – collection, examination following stimulation of pancreas; analysis; malabsorption syndrome due to intestinal disease and pancreatic dysfunction, differential diagnosis. Disaccharides deficiency.

SUGGESTED READINGS:

1. Essentials of Food and Nutrition, Vol. I & II, M. S. Swaminathan.

2. Text Book of Biochemistry with clinical correlations. Thomas M. Devlin (JohnWily).

3. Harper's Review of Biochemistry, Murray et al. (Longman).

4. Biochemical aspects of human disease – R.S. Elkeles and A.S. Tavil. (Blackwell ScientificPublications).

5. Clinical chemistry in diagnosis and treatment–JoanF.Zilva and P.R.Pannall (Lloyd-Luke Medical Books.

24RBTE306 **Bioreactor Design and Analysis** **4H- 4C**

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

End Semester Exam: 3 Hours

UNIT I

Introduction and Review of Bio-reaction engineering concepts, Mass transfer effects in heterogeneous reaction. Stirred tank batch bioreactor: stirred batch bio reactor for enzymes, cell cultures. Computers in fermentation, modeling, software sensors, control and supervision of fermentation processes. – off-line / online measurements – PID

UNIT II

Continuous Stirred Tank Bioreactor : Continuous operation of mixed reactor, enzyme reactions in a mixed reactor, performance equation for M-M kinetics, substrate inhibition kinetics and product inhibition kinetics, chemostat with cell cultures –steady state cell and substrate concentrations and productivity as a function of dilution rate, CSTR with immobilized enzymes, operation of CSTR in a constant feed rate policy-simulation for conversions with and without diffusion limitations, chemostat in series, Graphical design

UNIT III

Plug Flow and Packed Bed Bioreactor: Performance equation with MichelinMenten kinetics, substrate inhibition and product inhibition, plug flow reactor for immobilized enzymes, operation of plug flow reactor in constant feed rate policy, simulation for conversion with and without diffusion limitations. Fed–batch reactor: Applications of fed reactor, Fed batch operation of mixed reactor, material balance on cell and substrate.

UNIT IV

Recycle system: Chemostat with recycle, Biological waste water treatment, Feed forward control of the activated sludge process. The Transient Behavior of Bioreactors: Stability analysis, Stability of the chemostat, Stability of chemostat with substrate inhibition, Operating diagram, Transient responses of the chemostat, control of the chemostat, Turbidostat operation, Nutristat operation

UNIT V

Design of a fermenter: Basic function of a fermenter for microbial or animal cell culture, basic bioreactor design criteria, overview of bioreactor types-stirred tank bioreactor, bubble column bioreactor, air-lift reactor, propeller loop reactor, jet loop reactor, schematic overview of a fermenter with control system, operating issues that affect reactor design, aeration and oxygen mass transfer in

bioreactor system, design of chemostat. Instrumentation and control: Methods of measuring process variables, measurement and control of dissolved oxygen, pH measurements and Non-ideal flow: Non-ideal flow, RTD, E,C,F-curves

SUGGESTED READINGS:

1. Blanch H.W and Douglas S. Clark, Biochemical Engineering, CRC Press, 1997.
2. Michael L Shuler and Fikret Kargi, Bioprocess Engineering: Basic Concepts, Prentice-Hall of India Pvt Ltd, 2008.
3. Stanbury P.F., Whitaker A. and Hall S.J, Principles of Fermentation Technology. Elsevier India Pvt Ltd, 2007.

24RBTE307 **Advanced Systems Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modelling, Networks and graph theory: Basic properties of Network: Degree, average degree and degree distribution. Adjacency matrix, eighted and unweighted networks, Bipartite network, Paths and distances, Random Networks: Erdos-Renyi model, Small- world effect, clustering coefficient, Scale-free networks: Power laws, Hubs, ultra-small property, degree exponent, The Barabasi-Albert Model. Degree correlations: assortativity and disassortativity.

UNIT II

Kinetic modelling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modelling.

UNIT III

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks.

UNIT IV

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT V

Tools and databases for modelling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors.

SUGGESTED READINGS:

1. Klipp, E., Liebermeister, W., Wierling, C., Kowald, A., & Herwig, R. (2016). Systems biology: a textbook. John Wiley & Sons.

2. Alon, U. (2006). An introduction to systems biology: design principles of biological circuits. Chapman and Hall/CRC.
3. Klipp, E., Herwig, R., Kowald, A., Wierling, C., & Lehrach, H. (2008). Systems biology in practice: concepts, implementation and application. John Wiley & Sons.
4. Kitano, H. (Ed.). (2001). Foundations of systems biology (pp. 1-36). Cambridge: MIT press.
5. Alberghina, L., & Westerhoff, H. V. (Eds.). (2007). Systems biology: definitions and perspectives (Vol. 13). Springer Science & Business Media.

24RBTE308 **Advances in Cancer Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Epidemiology of cancer: environmental factors: tobacco, alcohol, diet, occupational exposure, hormones; Development and causes of cancer: Types of cancer, Development of cancer, Causes of cancer, properties of cancer cells, Transformation of cells in culture; Genetic basis of cancer: Oncogenes and tumor suppressor genes, apoptosis, multiple mutations in cancer - metastasis and angiogenesis, tumor viruses- Role of virus infection and human cancer.

UNIT II

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis; DNA repair mechanisms – DNA repair defects and their relationship to cancer.

UNIT III

Cancer Screening (Breast, Cervical, Colorectal, Prostate, Ovarian and Lung Cancer); Common practice of diagnostic methods, cytogenetics and molecular test, routine diagnostic test, purpose of frozen section, biopsy, endoscopy, diagnostic imaging, blood test, Proteomics and genomic approach, microarray, Discovery of metabolic biomarker; sample analysis, metabolic imaging strategies (CT, MRI, PET & SPECT); bioinformatics for metabolomics data.

UNIT IV

Different forms of therapy - Chemotherapy, Hormone therapy, Radiation Therapy, Immunotherapy, Endocrine therapy, Vaccines and immune stimulation, Gene therapy: molecular targeted therapies and anti-angiogenic therapies; Detection of Cancers; Prediction of aggressiveness of Cancer; Advances in Cancer detection.

UNIT V

Tomotherapy, robotic surgery, brachytherapy, hyperthermia, alternative treatments for cancer use of herbals and nonconventional therapies, development and synthesis of new drugs and their effects; photodynamic therapy; anti-angiogenic therapy, radio-immunotherapy, cancer stem cell therapy, stem cell transplant autologous, allogeneic, syngeneic transplant, cryotherapy, laser therapy.

SUGGESTED READNGS:

1. Tannock, I. F. (2013). The basic science of oncology. 2nd edition. McGraw-Hill.
2. Knowles Margaret & Selby Peter. (2005). An Introduction To Cellular and Molecular Biology of Cancer. 4th Edition. Oxford University Press.
3. Vincent T. Devita, Theodore S. Lawrence, Steven A. Rosenberg. (2008). Cancer: Principles & Practice of Oncology. 8th Edition. Lippincott Williams and Wilkins.
4. King R.J.B.,. (2006). Cancer Biology. 3rd Edition. Pearson Prentice Hall.
5. Bunz, F. (2008). Principles of cancer genetics (Vol. 1). New York, NY, USA: Springer.
6. Dimmock, N. J., Easton, A. J., & Leppard, K. N. (2016). Introduction to modern virology. John Wiley & Sons.
7. Edmund C Lattime, Stanton L Gerson. (2013). Gene Therapy of Cancer. Academic Press. Elsevier.

24RBTE309 **Advanced Drug Delivery Systems** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Modes of drug delivery – Absorption Distribution Metabolism Excretion characteristics of Drugs – Kinetics of Drug delivery - controlled drug delivery - site specific drugs - barriers for drug targeting - passive and active targeting Strategies for site specific - time and rate controlled delivery of drugs - antibody based and metabolism-based drug delivery systems.

UNIT II

Classification of Targetted Drug Delivery systems - Nanoparticles surface modification – bioconjugation – PEGylation – antibodies - cell-specific targeting and controlled drug release - Multi-Functional Gold Nanoparticles for Drug Delivery - Virus Based-nanoparticles for targeted Drug Delivery systems.

UNIT III

Polymers - Classification - Polymer Micelles as Drug Carriers- Polymers nanotubes- Magnetic Nanoparticles as Drug Carriers- Dendrimers - Synthesis – Tectodendrimers - Nanoscale containers – Nanoscafold systems – Gene transfection – Carbon nanotubes in diagnosis and therapy - Liposomes for pharmaceutical and cosmetic applications - Liposomal Drug Carriers in Cancer Therapy - lipid-DNA complexes – liposomal peptide and protein drug delivery Liposomal anticancer and antifungal agents.

UNIT IV

Targeted delivery through enhanced permeability and retention – Cancer markers Folate receptors - Targeting through angiogenesis - Targeting to specific organs or tumor types - Tumor-specific targeting – Combination therapy – Neutron Capture therapy - Targeting tumor vasculature for Imaging - Delivery of specific anticancer agents: Paclitaxel, Doxorubicin,5- Fluorouracil.

UNIT V

Vascular Zip Codes and Nanoparticle Targeting – Theragnostic Metal Nanoshells Photothermally-modulated Drug Delivery Using Nanoshell-Hydrogel Composites Nanoporous Microsystems for Islet Cell Replacement - Molecularly-derived Therapeutics - Transdermal Drug Delivery using Low-Frequency Sonophoresis Nanoporous Implants for Controlled Drug Delivery- Functionalized Cyclodextrin nanoparticles.

SUGGESTED READNGS:

1. Vladimir,P.Torchilin. (2006). Nanoparticulates as drug carriers. Imperial College Press.
2. Deepak Thassu., Michel Deleers., Yashwant Vishnupa. (2007). Nanoparticulate drug delivery systems. CRC Press
3. Tekade, R. K. (2019). Drug delivery systems. Academic Press.
4. Mitra, A., Lee, C. H., & Cheng, K. (2013). Advanced drug delivery. John Wiley & Sons.