DEGREE OF DOCTOR OF PHILOSOPHY
IN
ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI
(2024-2025)

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

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University, Established Under Section 3 of UGC Act 1956)
COIMBATORE 641 021 INDIA

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, 2024 onwards will be governed by this regulation)

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

Karpagam Academy of Higher Education

(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the Second Cycle)
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Regulations for Ph.D.,Full Time (FT) / Part Time (PT)

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. For every scholar, the Supervisor shall furnish a Panel of three experts with doctoral qualification who have produced Ph.D., Candidates in the field of proposed research, from the other Academic Institutions / National Laboratories and any other research laboratories, from whom one will be nominated as a member. The Supervisor of the 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 Head of the Department concerned with Ph.D., qualification shall be an internal member. If the HOD is the Supervisor, the next senior faculty with Ph.D., Degree shall be the member. If a Doctoral Committee member is away from his/her place of work for a longer period, the 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 anidentical 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

award of the degree of

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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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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 22

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* : Good/Satisfactory/Needs improvement
    (additional sheets may be used) (Tick whichever is applicable)
11. After the Pre-submission Presentation whether the scholar may be permitted to submit the Thesis : Permitted/Extended for one year
    (Strike out whichever is not applicable)

Signature:

Research Scholar **Research Supervisor** **HOD** **Dean**

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

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FORMAT – IV Annexure

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

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

Topic of the Research work:

Q1.
Answer:

Q2.
Answer:

Q3.
Answer:

Q4.
Answer:

Q5:
Answer:

Signature of

Research Scholar **Research Supervisor**

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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

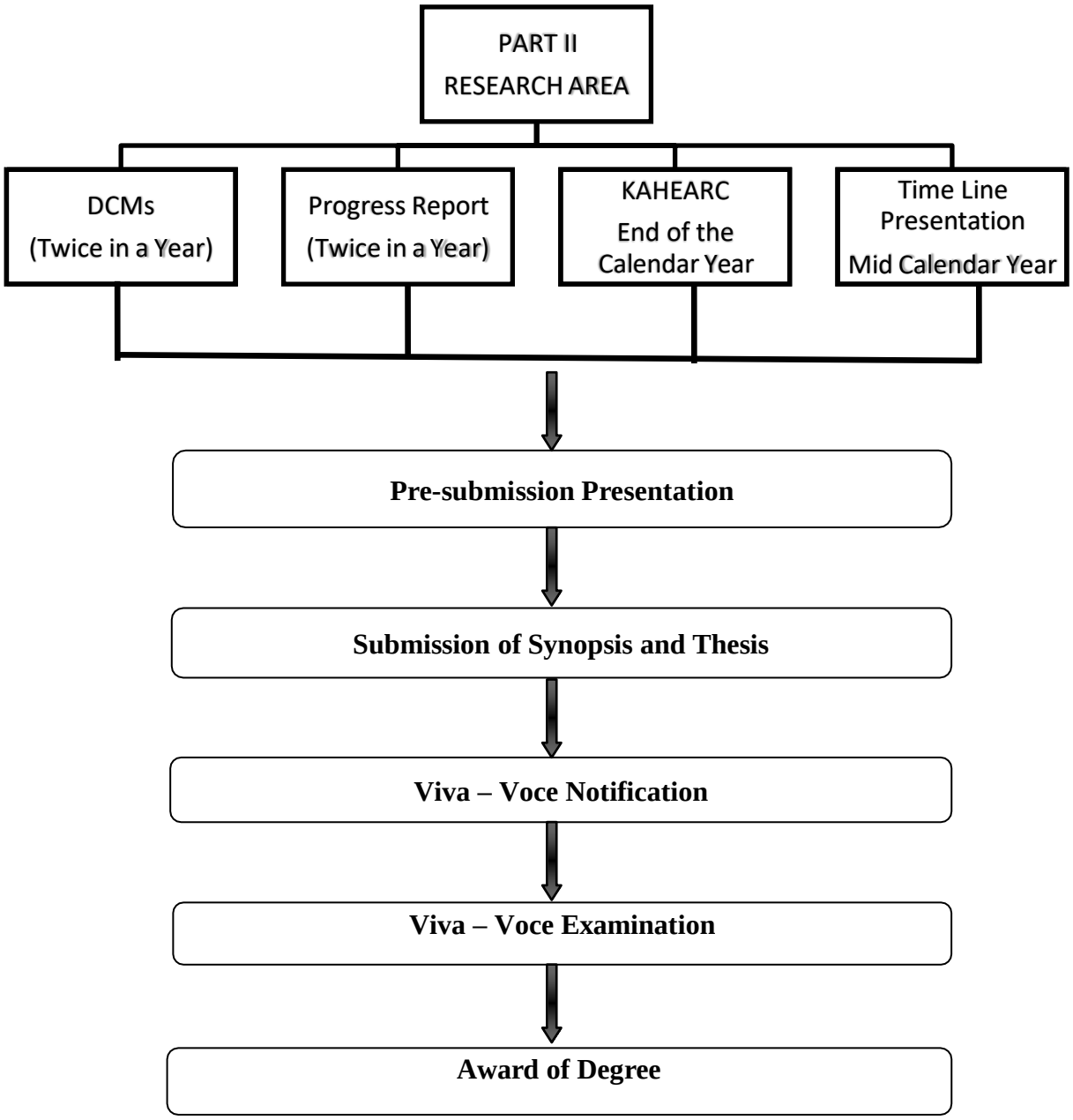
Certificate of Plagiarism

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 touncover 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 than8,500 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 GordonFoster, 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 issuedby the ISBN Registration Agency that is responsible for that country or territory. The rangesof ISBNs assigned to any particular country are based on the publishing profile of the countryconcerned.

PART – I

COURSE WORK SYLLABUS FOR Ph.D COURSE IN ELECTRONICS AND COMMUNICATION ENGINEERING

S.NO	COURSE CODE	TITLE OF THE COURSE	C	EXAM HRS	MARKS
1	24RECE101	PAPER I-Research Methodology and Pedagogy	4	3	100
2	24RECE201	PAPER II-Research and Publication Ethics	4	3	100
3	24RECE301	PAPER III Synthesis and Optimization of Digital Circuits	4	3	100
4	24RECE302	PAPER III Advanced DSP	4	3	100
5	24RECE303	PAPER III Soft Computing	4	3	100
6	24RECE304	PAPER III Wireless Sensor Networks	4	3	100
7	24RECE305	PAPER III VLSI signal processing	4	3	100
8	24RECE306	PAPER III Wavelets and Multi-Resolution Processing	4	3	100
9	24RECE307	PAPER III Computer Vision and Image processing	4	3	100
10	24RECE308	PAPER III-Special Paper I:Machine Learning and Deep Learning	4	3	100
11	24RECE309	Paper III-Special Paper II Mobile Ad-Hoc Networks	4	3	100
12	24RECE310	Paper III-Special Paper III: Network Routing Algorithms	4	3	100
13	24RECE311	PAPER III-Special PAPER IV: Low Power VLSI Design	4	3	100
14	24RECE312	Paper III-Special Paper V: Testing of VLSI Circuits	4	3	100
15	24RECE313	Paper III- Special Paper VI: Advanced Digital Image Processing	4	3	100
16	24RECE314	Paper III-Special Paper VII: Bio-Medical Signal Processing	4	3	100
17	24RECE315	Paper III-Special Paper VIII: Pattern Recognition	4	3	100
18	24RECE316	Paper III-Special Paper IX: Design of Analog and Mixed Mode VLSI Circuits	4	3	100
		TOTAL	**72**	**54**	**1800**

24RECE101 PAPER I: RESEARCH METHODOLOGY AND PEDAGOGY 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 **Marks: External 100 Total 100**

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To highlights the various postulates of research problems, research design, writing a thesis and modern statistical methods.
- o enable the researchers to carry out research problem individually in a perfect scientific method.
- To study on various sampling techniques
- To understand the fundamentals of hypothesis testing
- To know the pedagogical methods in higher learning objectives and roll of higher education

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understand the various postulates of research problems, research design, writing a thesis and modern statistical methods.
- Enable the researchers to carry out research problem individually in a perfect scientific method.
- Gain knowledge on various sampling techniques
- Gain knowledge on the fundamentals of hypothesis testing
- Understand the pedagogical methods in higher learning objectives and roll of higher education

UNIT I INTRODUCTION TO RESEARCH 12

Research – Definition – Importance and Meaning of research – Characteristics of research – Types of Research – Steps in research – Identification, Selection and formulation of research problem – Research questions – Research design – Formulation of Hypothesis – Review of Literature.

UNIT II SAMPLING TECHNIQUES 12

Sampling techniques: Sampling theory – types of sampling – Steps in sampling – Sampling and Non-sampling error – Sample size – Advantages and limitations of sampling. Collection of Data: Primary Data – Meaning – Data Collection methods – Secondary data – Meaning – Relevances, limitations and cautions.

UNIT III STATISTICS IN RESEARCH 12

Statistics in Research – Measure of Central tendency – Dispersion – Skewness and Kurtosis in research. Hypothesis – Fundamentals of Hypothesis testing – Standard Error – Point and Interval estimates – Important Non-Parametric tests : Sign, Run, Kruskal – Wallis tests and Mann-Whitney test.

UNIT IV TESTING METHODS 12

Para metric tests : Testing of significance – mean, Proportion, Variance and Correlation – testing for Significance of difference between means, proportions, variances and correlation co-efficient. Chi-square

tests – ANOVA – One-way and Two-way. Research Report : Types of reports – contents – styles of reporting – Steps in drafting reports – Editing the final draft – Evaluating the final draft.

UNIT V PEDAGOGICAL METHODS IN HIGHER LEARNING 12

Pedagogical Methods in Higher Learning 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 storing, case discussion, and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: - 'e' learning researches – web based learning

TOTAL:60

SUGGESTED READINGS:

1. Gupta S.P. (2017) Statistical Methods Sultan Chand & Sons – Tb Publishers (P) Ltd.
2. Kothari C.R.(2004) Research Methodology Methods and Techniques-New age International (P) Ltd.Publishers.
3. Gupta B.N. Statistics(2015) (Theory and Practice) Publishers (P) Ltd SBPD Publications (P) Ltd.
4. Santosh Gupta, Research Methodology and Statistical Techniques, Publisher (P) New Delhi, Deep and Deep Publications Pvt. Ltd., 2010.
5. Rajasekar.S (2005) Computer Education and educational computing. Hyderabad: Neelkamal Publications.
6. Kumar K.L. (1997) Educational Technologies, New Delhi: New age International (P) Ltd.Publishers.

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24RECE201 PAPER II: RESEARCH PUBLICATION ETHICS 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To learn about the research philosophy and ethics
- To understand fabrication and plagiarism in publications
- To understand publication ethics
- To know about subject specific ethical issues
- To gain in depth knowledge on databases and research metrics

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Gain knowledge on research philosophy and ethics
- Understand fabrication and plagiarism in publications
- Understand publication ethics
- Know about subject specific ethical issues
- Gain in depth knowledge on databases and research metrics

THEORY

UNIT I: PHILOSOPHY AND ETHICS 8

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

UNIT II: SCIENTIFIC CONDUCT 8

Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconduct: Falsification – Fabrication and Plagiarism (FFP) – Redundant publications: duplicate and overlapping publications – salami slicing – Selective reporting and misrepresentation of date.

UNIT III: PUBLICATION ETHICS 8

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

UNIT IV: PUBLICATION MISCONDUCT 8

Group Discussion: 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 **8**

Database: Indexing database – Citation database: Web of Science, Scopus, etc.
Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score – Metrics: h-index, g index, i10 index, altimetric.

UNIT VI: DEVELOPMENT OF E-CONTENT & IPR **8**

Integrated Library Management System (ILMS) : e-journals – e-books – e-shodhsindu – Shodhganga – Database – e-content Development – Learning Management System (LMS) – e-PG- Pathshala – CEC (UG) SWAYAM – MOOCs – NPTEL – NMEICT.
IPR: Patent – Copyrights – Trademark – Geographical Indication.

PRACTICE **12**

Open Access Publishing

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

TOTAL:60

SUGGESTED READING:

Peer Review and Manuscript Management in Scientific Journals, Guidelines for Good Practice, Irene Hames, Blackwell Publishing, 2007

24RECE301 PAPER III: SYNTHESIS AND OPTIMIZATION OF DIGITAL CIRCUITS 4H:4C

Instruction hours/week: L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To understand about microelectronic design styles, computer aided synthesis and optimization techniques
- To know about distinctive features of hardware modeling languages
- To understand scheduling algorithms
- To understand two level and multi level combinational logic optimization algorithms
- To know about synthesis of testable network

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understand about microelectronic design styles, computer aided synthesis and optimization techniques
- Know about distinctive features of hardware modeling languages
- Understand scheduling algorithms
- Understand two level and multi level combinational logic optimization algorithms
- Gain knowledge about synthesis of testable network

UNIT-I INTRODUCTION 12

Microelectronics, semiconductor technologies and circuit taxonomy, Microelectronic design styles, computer aided synthesis and optimization. Graphs: Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms, Boolean algebra and Applications.

UNIT-II HARDWARE MODELING & SCHEDULE ALGORITHMS 12

Hardware Modeling Languages, distinctive features, structural hardware language, Behavioral hardware language, HDLs used in synthesis, abstract models, structures logic networks, state diagrams, data flow and sequencing graphs, compilation and optimization techniques. Schedule Algorithms: A model for scheduling problems, Scheduling with resource and without resource constraints, Scheduling algorithms for extended sequencing models, Scheduling Pipe lined circuits.

UNIT-III TWO LEVEL COMBINATIONAL LOGIC OPTIMIZATION 12

Logic optimization, principles, operation on two level logic covers, algorithms for logic minimization, symbolic minimization and encoding property, minimization of Boolean relations.

UNIT-IV MULTIPLE LEVEL COMBINATIONAL OPTIMIZATIONS 12

Models and transformations for combinational networks, algebraic model, Synthesis of testable network, algorithm for delay evaluation and optimization, rule based system for logic optimization.

UNIT-V SEQUENTIAL CIRCUIT OPTIMIZATION & CELL LIBRARY BINDING 12

Sequential circuit optimization using state based models, sequential circuit optimization using network models. Problem formulation and analysis, algorithms for library binding, specific problems and algorithms for library binding (lookup table F.P.G.As and Antifuse based F.P.G.As), rule based library binding.

TOTAL:60

SUGGESTED READINGS:

1. Giovanni De Micheli, “Synthesis and Optimization of Digital Circuits", Tata McGraw-Hill, 2003.
2. Srinivas Devadas, Abhijit Ghosh, and Kurt Keutzer, “Logic Synthesis”, McGraw-Hill, USA, 1994.
3. Neil Weste and K. Eshragian,b, “Principles of CMOS VLSI Design: A System Perspective”, 2nd edition, Pearson Education (Asia) Pte. Ltd., 2000.
4. Kevin Skahill, “VHDL for Programmable Logic”, Pearson Education (Asia) Pte. Ltd., 2000.

24RECE302 PAPER III: ADVANCED DSP 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To understand factors and application of multirate digital signal processing
- To gain in depth knowledge on frequency response of LTI systems
- To understand linear prediction
- To gain knowledge on optimum linear filters
- To gain knowledge in wavelet transform

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understand factors and application of multirate digital signal processing
- Gain in depth knowledge on frequency response of LTI systems
- Understand linear prediction
- Gain knowledge on optimum linear filters
- Gain knowledge in wavelet transform

UNIT 1 : MULTIRATE DIGITAL SIGNAL PROCESSING 12

Introduction, Decimation by a factor 'D', Interpolation by a factor 'I', Sampling rate Conversion by a factor 'I/D', implementation of Sampling rate conversion, Multistage implementation of Sampling rate onversion, Sampling rate conversion of Band Pass Signals, Sampling rate conversion by an arbitrary factor, Applications of Multirate Signal Processing, Digital Filter banks, Two Channel Quadrature Mirror Filter banks, MChannel QMF bank (Text 1).

UNIT 2 : TRANSFORM ANALYSIS OF LTI SYSTEMS 12

The frequency response of LTI systems, System functions for systems characterized by linear constant coefficient difference equations, frequency response for rational system functions, Relationship between magnitude and phase, All pass systems, minimum phase systems, linear systems with generalized linear phase (Text 2).

UNIT 3 : LINEAR PREDICTION AND OPTIMUM LINEAR FILTERS 12

Representation of a random process, Forward and backward linear prediction, Solution of normal equations, Properties of the linear error-prediction filters, AR lattice and ARMA lattice-ladder filters, Wiener filters for filtering and prediction.

UNIT 4: TIME FREQUENCY TRANSFORMATION 12

The Fourier Transform: Its Power and Limitations, The short Time Fourier Transform, The Gabor transform, The wavelet transform, Perfect reconstruction Filter Banks and Wavelets, Recursive Multi resolution Decomposition, Haar Wavelet.

UNIT 5: HARDWARE AND SOFTWARE FOR DIGITAL SIGNAL PROCESSORS 12

Digital signal processor architecture, Digital signal processor hardware units, Fixed- point and floating-point formats

TOTAL:60

SUGGESTED READINGS:

1. Proakis and Manolakis, "Digital Signal Processing", Prentice Hall, 4th edition, 1996.
2. Alan V. Oppenheim and Ronald W.Schafer, "Discrete-Time signal Processing", PHI Learning, 2003.
3. Roberto Cristi, "Modern Digital Signal Processing", Cengage Publishers, India, Eerstwhile Thompson Publications, 2003.
4. Li Tan, "Digital Signal Processing – Fundamentals and Applications", Elsevier, 2008.
5. S.K.Mitra, "Digital Signal Processing: A Computer Based Approach", 3rd edition, Tata McGraw Hill, India, 2007.

24RECE303 PAPER III: SOFT COMPUTING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To understand machine learning basics
- To gain in depth knowledge of genetic algorithms
- To understand supervised learning neural networks and unsupervised learning neural networks
- To gain knowledge on fuzzy logic concepts
- To gain knowledge advances in neural networks

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understand machine learning basics
- Gain in depth knowledge of genetic algorithms
- Understand supervised learning neural networks and unsupervised learning neural networks
- Gain knowledge on fuzzy logic concepts
- Gain knowledge advances in neural networks

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS 12

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics.

UNIT II GENETIC ALGORITHMS 12

Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition.

UNIT III NEURAL NETWORKS 12

Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architectures – Advances in Neural networks.

UNIT IV FUZZY LOGIC 12

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

UNIT V NEURO-FUZZY MODELING 12

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rulebase Structure Identification – Neuro-Fuzzy Control – Case studies.

TOTAL:60

SUGGESTED READINGS:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani,(2003) "Neuro-Fuzzy and Soft Computing", Prentice-Hall of Indi,.
2. George J. Klir and Bo Yuan,(1995) "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall.
3. James A. Freeman and David M. Skapura,(2003) "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn.,.
4. Mitchell Melanie,(1998) "An Introduction to Genetic Algorithm", Prentice Hall,.
5. David E. Goldberg,(1997) "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley,.

24RECE304 PAPER III: WIRELESS SENSOR NETWORKS 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 **Marks: External 100 Total 100**

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To understand network architecture
- To study about communication fundamentals
- To understand data link layer
- To write case study of target detection tracking etc
- To understand IEEE 802.15.4 low rate WPAN

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understand network architecture
- Study about communication fundamentals
- Understand data link layer
- Write case study of target detection tracking etc
- Understand IEEE 802.15.4 low rate WPAN

UNIT I INTRODUCTION 12

Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture –Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks– WINS, μAMPS Underwater Acoustic and Deep space networks.

UNIT II PHYSICAL LAYER 12

Introduction wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management.

UNIT III DATA LINK LAYER 12

MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, Link Layer protocols –fundamentals task and requirements, error control, framing, link management.

UNIT IV NETWORK LAYER 12

Gossiping and agent-based uni cast forwarding , Energy-efficient unicast, Broadcast and multicast,

geographic routing , mobile nodes, Data –centric and content-based networking –Data –centric routing, Data aggregation, Data-centric storage, Higher layer design issues.

UNIT V CASE STUDY **12**

Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Sensor Network Platforms and tools-Sensor node hardware, Node-level software platforms, node – level simulators.

TOTAL:60

SUGGESTED READINGS:

1. Feng zhao, Leonidas (2004), Wireless Sensor Networks An information processing approach – guibas, Elsivier publication,.
2. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati,(2004)- Wireless Sensor Networks – Springer publication,.
3. Holger Karl, Andrea's willig, John(2006) Wireless Sensor Networks: Architecture and protocol – Edgar H .Callaway, CRC press.Protocol and Architecture for Wireless Sensor Networks –wiley publication.
4. Wireless Sensor Networks: First European workshop, EWSN 2004, Berlion, germany, January 2004 proceedings –Holger Karl, Andreas willig, Adam holisz, Springer publication.
5. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.
6. Jamal N. Al-karaki, Ahmed E. Kamal," Routing Techniques in Wireless sensor networks: A survey", IEEE wireless communication, December 2004, 6 – 28.

24RECE305 PAPER III: VLSI SIGNAL PROCESSING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student Data flow and Dependence graphs in digital filter design
- To familiarize the student about algorithmic strength reduction in filters and transforms
- To imparts a good knowledge about Look-Ahead pipelining in first-order IIR filters
- To acquaint the student with various - bit-level arithmetic architectures.
- Provide students the insight multiple constant multiplication

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understanding of the ideas Data flow and Dependence graphs in digital filter design
- Students will be able to demonstrate a knowledge and broad understanding about algorithmic strength reduction in filters and transforms
- Gain a good knowledge about various Look-Ahead pipelining in first-order IIR filters
- Acquire knowledge about various - bit-level arithmetic architectures
- Understanding the design of Cross layer and its optimization techniques.

UNIT I - PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS 12

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs – critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II – ALGORITHMIC STRENGTH REDUCTION TECHNIQUE 12

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – parallel FIR filter, parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT- III ALGORITHIMIC STRENGTH REDUCTION 12

Fast convolution –Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV - BIT-LEVEL ARITHMETIC ARCHITECTURES 12

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, bit-serial FIR filter, CSD representation, CSD multiplication, Distributed Arithmetic fundamentals and FIR filters

UNIT V- NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING **12**

Numerical strength reduction – sub expression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

TOTAL:60

SUGGESTED READINGS:

1. Keshab K. Parhi, (2007)"VLSI Digital Signal Processing Systems, Design and implementation ", Wiley, Interscience, 2007.
2. U. Meyer – Baese,(2004) "Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition.

24RECE306 PAPER III: WAVELETS AND MULTI-RESOLUTION PROCESSING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student familiarize with vector spaces and its properties
- To familiarize the student about Multi Resoultion Analysis (MRA)
- To imparts a good knowledge on continuous wavelet transform
- To acquaint the student scale plane for CWT.
- Provide students the insight discrete wavelet transform

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understanding with vector spaces and its properties
- Students will be able to demonstrate Multi Resoultion Analysis (MRA)
- Gain a good knowledge about continuous wavelet transform
- Acquire knowledge about scale plane for CWT
- Understanding the design the insight discrete wavelet transform

UNIT I - INTRODUCTION 12

Vector Spaces - properties - dot product - basis - dimension, orthogonality and orthonormality - relationship between vectors and signals - Signal spaces – concept of Convergence - Hilbert spaces for energy signals - Generalized Fourier Expansion.

UNIT I I- MULTI RESOLUTION ANALYSIS 12

Definition of Multi Resolution Analysis (MRA) – Haar basis - Construction of general orthonormal MRA-Wavelet basis for MRA – Continuous time MRA interpretation for the DTWT – Discrete time MRA- Basis functions for the DTWT – PRQMF filter banks.

UNIT- III CONTINUOUS WAVELET TRANSFORM 12

Wavelet Transform - definition and properties - concept of scale and its relation with frequency - Continuous Wavelet Transform (CWT) - Scaling function and wavelet functions (Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal) – Tiling of time -scale plane for CWT.

UNIT IV - DISCRETE WAVELET TRANSFORM 12

Filter Bank and sub band coding principles - Wavelet Filters - Inverse DWT computation by Filter banks -Basic Properties of Filter coefficients - Choice of wavelet function coefficients - Mallat's algorithm for DWT - Lifting Scheme: Wavelet Transform using Polyphase matrix Factorization – Geometrical foundations of lifting scheme - Lifting scheme in Z –domain.

UNIT V- APPLICATIONS **12**

Image Compression using DWT – Sequential / Progressive - JPEG 2000 standard - Image denoising - Edge detection and object Isolation and Object Detection - Image Fusion -Wavelet Packets ,Multiwavelets - Non linear wavelets – Ridgelets – Curvelets – Contourlets.

TOTAL:60

SUGGESTED READINGS:

1. C. Sidney Burvus, Ramesh A.Gopinath haito ,(1995) “Introduction to wavelets and wavelet Transform”, Prentice Hall International,.
2. Gilbert Strang, “Linear Algebra and its Applications”, 3rd edition.
3. J.C. Goswami, A.K. Chan,(1999) “Fundamentals of wavelets”, John wiley and sons.
4. Mallat S., (1996)"Wavelet Signal Processing”, Academic Press,.

24RECE307 PAPER III: COMPUTER VISION AND IMAGE PROCESSING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 **Marks: External 100 Total 100**

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To know about image formation and coordinate transformations
- To understand various parameters in image processing
- To familiarize with segmentation techniques
- To gain knowledge on Bayesian Classification
- To acquire knowledge on Temporal sequence learning

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Gain knowledge on image formation and coordinate transformations
- Understand various parameters in image processing
- Familiarize with segmentation techniques
- Gain knowledge on Bayesian Classification
- Acquire knowledge on Temporal sequence learning

UNIT I - IMAGE FORMATION 12

Image Formation and Coordinate Transformations, Camera Matrix, Motion/Stereo Pin-hole model, Human eye, cognitive aspects of colour space; illumination; Sampling and Quantization, Coordinate transformations and camera parameters.

UNIT II – IMAGE PROCESSING 12

Noise Removal, Blurring, Edge Detection: Canny , Gaussian,Gabor,Texture Edges, Curvature , Corner Detection.

UNIT III – SEGMENTATION 12

Types of segmentation techniques, Watershed, Change Detection, Background Subtraction, Texture Segmentation, Gaussian Mixture Models - Applications in Color based Image Segmentation, Background Modeling and Shape Clustering

UNIT IV - MACHINE LEARNING TECHNIQUES IN VISION 12

Bayesian Classification, Maximum Likelihood Methods, Neural Networks; Non-parametric models; Manifold estimation Support Vector Machines ; Temporal sequence learning

UNIT V - INTRODUCTION TO OBJECT TRACKING 12

Exhaustive vs. Stochastic Search Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models, Object Modeling and Recognition Applications: Surveillance, Object detection.

TOTAL:60

SUGGESTED READINGS:

1. David Forsyth and Jean Ponce, (2004) Computer Vision: A modern Approach, Prentice Hall, India .
2. Christopher Bishop,(2008) Pattern Recognition and Machine Learning, Springer.
3. E.R. Davies,(2005) Machine Vision, Theory Algorithms Practicalities, Elsevier .
4. Richard O. Duda, Peter E. Hart, and David G. Stork, (2002)Pattern Classification, 2nd ed., Wiley Asia.

24RECE308 PAPER III-SPECIAL PAPER I: MACHINE LEARNING AND DEEP LEARNING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- Understanding about the learning problem and algorithms
- Providing insight about neural networks
- Introducing the machine learning fundamentals and significance
- Enabling the students to acquire knowledge about pattern recognition.
- Motivating the students to apply deep learning algorithms for solving real life problems

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Illustrate the categorization of machine learning algorithms.
- Analyze with the pattern association using neural networks
- Examine various terminologies related with pattern recognition and architectures of convolutional neural networks
- Develop different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.
- Analyse swarm intelligence and ant colony for feature selection

UNIT I MACHINE LEARNING FUNDAMENTALS 12

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT II NEURAL NETWORKS 12

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 12

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT IV DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 12

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs.

UNIT V SWARM OPTIMIZATION AND FIREFLY ALGORITHM 12

Swarm intelligence - PSO algorithm - accelerated PSO - implementation – convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varientsAnt colony optimization toward feature selection.

TOTAL:60

REFERENCES:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
6. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014
7. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

24RECE309 PAPER III-SPECIAL PAPER II: MOBILE AD-HOC NETWORKS 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student acquire sound knowledge of adhoc networks and its characteristics and features
- To familiarize the student with MAC Protocols and scheduling algorithms.
- To imparts a good knowledge about design issues and classification of Routing protocols.
- To acquaint the student with various Routing protocols algorithms.
- Provide students the insight useful for understanding the end to end delivery and security issues using Adhoc transport protocols

COURSE OUTCOMES :

At the end of the course the research scholars will be able to :

- Understanding of the ideas of Adhoc mobility models
- Students will be able to demonstrate a knowledge and broad understanding ofIEEE standards protocols
- Gain a good knowledge about various routing algorithms.
- Acquire knowledge about security issues in adhoc networks.
- Understanding the design ofCross layer and its optimization techniques.

UNIT I INTRODUCTION 12

Introduction to adhoc networks – definition, characteristics features, applications. Charectristics of Wireless channel, Adhoc Mobility Models:- Indoor and outdoor models.

UNIT II MEDIUM ACCESS PROTOCOLS 12

MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III NETWORK PROTOCOLS 12

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV END-END DELIVERY AND SECURITY 12

Transport layer : Issues in desiging- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G 12

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary prespective. Intergration of adhoc with Mobile IP networks.

TOTAL:60

SUGGESTED READINGS:

1. C.Siva Ram Murthy and B.S.Manoj,(2007)' Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic,(2004) Mobile adhoc networking, Wiley-IEEE press,.
4. Mohammad Ilyas, (2002)The handbook of adhoc wireless networks, CRC press,.
5. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Commun. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
6. A survey of integrating IP mobility protocols and Mobile Ad hoc networks, Fekri M. Abduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, v 9.no.1 2007
7. V.T.Raisinhani and S.Iyer "Cross layer design optimization in wireless protocol stacks"Comp. communication, vol 27 no. 8, 2004.
8. V.T.Raisinhani and S.Iyer,"ÉCLAIR; An Efficient Cross-Layer Architecture for wireless protocol stacks",World Wireless cong., San francisco,CA,May 2004.
9. V.Kawadia and P.P.Kumar,"A cautionary perspective on Cross-Layer design,"IEEE Wireless commn., vol 12, no 1,2005.

24RECE310 PAPER III - SPECIAL PAPER III: NETWORK ROUTING ALGORITHMS 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To familiarize the student with various Routing in Telephone Network and Dynamic Alternative Routing.
- To acquaint the student with various routing protocols in Packet switching networks.
- To make the student acquire sound knowledge of different protocols used in optical and ATM networks
- To familiarize the student with the concepts of routing in the PLANET network and deflection routing
- To imparts a good knowledge about Routing in Cellular Mobile Radio Communication networks.

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understanding of the ideas of Real Time Network routing and Dynamic alternative routing
- Students will be able to demonstrate a knowledge and broad understanding of Interior Gateway routing protocols and Exterior Gateway routing protocols
- Acquire a good knowledge about ATM address structure and its routing.
- Understand the concepts of mobility and routing in Cellular Digital Packet Data.
- Understanding the ideas of network architecture and mobility management in cellular systems

UNIT I CIRCUIT SWITCHING NETWORKS 12

AT & T's Dynamic Routing Network, Routing in Telephone Network-Dynamic Non Hierarchical Routing-Trunk Status Map Routing-Real Time Network Routing, Dynamic Alternative Routing-Distributed Adaptive Dynamic Routing-Optimized Dynamic Routing.

UNIT II PACKET SWITCHING NETWORKS 12

Distance vector Routing, Link State Routing, Inter domain Routing-Classless Interdomain routing (CIDR), Interior Gateway routing protocols (IGRP) - Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP), Apple Talk Routing and SNA Routing.

UNIT III HIGH SPEED NETWORKS 12

Routing in optical networks-The optical layer, Node Designs, Network design and operation, Optical layer cost tradeoffs, Routing and wavelength assignment, Architectural variations, Routing in ATM networks-ATM address structure, ATM Routing, PNNI protocol, PNNI signaling protocol, Routing in the PLANET network and Deflection Routing.

UNIT IV MOBILE NETWORKS **12**

Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture, Mobility management in cellular systems, Connectionless Data service for cellular systems, Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network, Routing algorithms for small, medium and large sized packet, radio networks.

UNIT V MOBILE AD-HOC NETWORKS (MANET) **12**

Internet based mobile ad-hoc networking, communication strategies, routing algorithms – Table-driven routing - Destination Sequenced Distance Vector (DSDV), Source initiated on demand routing- Dynamic Source Routing (DSR), Ad-hoc On- demand Distance Vector (AODV), Hierarchical based routing-Cluster head Gateway Switch Routing (CGSR) and Temporally-Ordered Routing Algorithm (TORA), Quality of Service.

TOTAL:60

SUGGESTED READINGS:

1. Steen strub.M,(1995), “Routing in Communication networks”, PH International, New York.
2. William Stallings,(2004), “ISDN & Broadband ISDN with Frame Relay & ATM”, PHI, New Delhi.
3. Behrouz A Forouzan,(2004), “Data Communications and Networking (3/e), TMH, New Delhi.
4. William Stallings,(1998), “High Speed Networks TCP/IP and ATM Design Principles”, Prentice Hall International, New York.
5. Mohammad Ilyas,(2002), “The Handbook of Ad hoc Wireless Networks”, CRC Press, USA.

24RECE311 PAPER III-SPECIAL PAPER IV: LOW POWER VLSI DESIGN 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 **Marks: External 100 Total 100**

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student acquire sound knowledge of power dissipation in CMOS FET devices.
- To familiarize the student with power optimization in Logical level and circuit level.
- To imparts a good knowledge about design of low power in CMOS circuits.
- To acquaint the student with Simulation power analysis and Probabilistic power analysis.
- Provide students the insight useful for understanding the Synthesis for low power .

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Acquire the knowledge of circuit techniques for reducing power consumption in adders and multipliers.
- Clear idea about the design of low power in CMOS FET devices.
- Understanding the ideas of power optimization in Logical level and circuit level.
- Gain knowledge in Computer Arithmetic techniques for low power systems.
- Discuss the power estimation and analysis at Logic level.

UNIT I POWER DISSIPATION IN CMOS 12

Sources of power dissipation – Physics of power dissipation in CMOS FET devices- Basic principle of low power design.

UNIT II POWER OPTIMIZATION 12

Logical level power optimization – Circuit level low power design: logic styles, transistor sizing and ordering – Circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 12

Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Advanced techniques: Adiabatic Computation, Asynchronous Circuits – Special techniques

UNIT IV POWER ESTIMATION AND ANALYSIS 12

Logic level power estimation – Simulation power analysis – Probabilistic power analysis

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 12

Synthesis for low power –Behavioral level transforms- Software design for low power – Software Power Estimation – Software Power Optimization

TOTAL:60

SUGGESTED READINGS:

1. Roy.K and Prasad.S.C, (2000) Low Power CMOS VLSI circuit design, Wiley, New Jersey.
2. Dimitrios Soudris, Chirstian Pignet, Costas Goutis,(2002) Designing CMOS Circuits For Low Power, Kluwer academic publishers, Boston,.
3. Kuo.J.B and Lou.J.H, (2009)Low voltage CMOS VLSI Circuits, Wiley, New Jersey,.
4. Chandrakasan.A.P and Broadersen.R.W, (1995)Low power digital CMOS design, Kluwer academic publishers, Boston .
5. Gary Yeap Practical low power digital VLSI design,(1998) Kluwer academic publishers, Boston.

24RECE312 PAPER III-SPECIAL PAPER V: TESTING OF VLSI CIRCUITS 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To familiarize the student with types of simulation and Delay models.
- To acquaint the student with test generation for combinational and sequential logic circuits.
- To make the student acquire sound knowledge of system level DFT approaches.
- To familiarize the student with testable memory design and its algorithms.
- To imparts a good knowledge about various design methods for testability.

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understanding the ideas of faults in digital circuits and its modelling.
- Gain knowledge in design of testable sequential circuits and combinational circuits.
- Discuss the Ad-hoc design and Generic scan-based design for testability.
- Clear idea about the BIST Architectures.
- Students will be able to demonstrate a knowledge and broad understanding of Test generation for Embedded RAMs.

UNIT I BASICS OF TESTING AND FAULT MODELLING 12

Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation – Types of simulation - Delay models - Gate level Event-driven simulation.

UNIT II TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS 12

Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

UNIT III DESIGN FOR TESTABILITY 12

Design for Testability - Ad-hoc design - Generic scan based design - lassical scan based design - System level DFT approaches.

UNIT IV SELF-TEST AND TEST ALGORITHMS 12

Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.

UNIT V FAULT DIAGNOSIS 12

Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

TOTAL:60

SUGGESTED READINGS:

1. M. Abramovici, M.A. Breuer and A.D. Friedman,(2002) "Digital Systems and Testable Design", Jaico Publishing House,.
2. P.K. Lala, (2002)"Digital Circuit Testing and Testability", Academic Press,.
3. M.L. Bushnell and V.D. Agrawal,(2002) "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,.
4. A.L. Crouch(2002), "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International,.

24RECE313 PAPER III-SPECIAL PAPER VI: ADVANCED DIGITAL IMAGE PROCESSING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student acquire sound knowledge of fundamentals of digital image processing.
- To familiarize the student with Watershed algorithm and Active contour methods for digital image processing.
- To imparts a good knowledge about Localized feature extraction and detection.
- To acquaint the student with Texture descriptors and wavelet features.
- To familiarize the student with Similarity transformation and Affine transformation.

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Students will be able to demonstrate a knowledge and broad understanding of various 2Dimage transforms.
- Clear idea about the various segmentation methods.
- Understanding the ideas of Hough transform and shape skeletonization.
- Gain knowledge in fundamentals of image fusion.
- Acquire the knowledge of Multiresolution based fusion discrete wavelet transform and Curvelet transform.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 12

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing.

UNIT II SEGMENTATION 12

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT III FEATURE EXTRACTION 12

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture Descriptors-Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 12

Registration-Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence-Point pattern matching, Line matching, region matching Template matching.

Transformation functions-Similarity transformation and Affine Transformation. Resampling-Nearest Neighbour and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION 12

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL:60

SUGGESTED READINGS:

1. John C.Russ, (2007)"The Image Processing Handbook", CRC Press,.
2. Mark Nixon, Alberto Aguado, (2008)"Feature Extraction and Image Processing", Academic Press,.
3. Ardeshir Goshtasby,(2005) " 2D and 3D Image registration for Medical, Remote Sensing andIndustrial Applications",John Wiley and Sons,
4. Rafael C. Gonzalez, Richard E. Woods, (2004) Digital Image Processing', Pearson,Education, Inc.,Second Edition,.
5. Anil K. Jain, (2002) Fundamentals of Digital Image Processing', Pearson Education,Inc.,.
6. Rick S.Blum, Zheng Liu,(2006)" Multisensor image fusion and its Applications",Taylor& Francis,.

24RECE314 PAPER III-SPECIAL PAPER VII: BIO-MEDICAL SIGNAL PROCESSING 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To familiarize the student with basic fourier transform algorithms.
- To imparts a good knowledge about the autoregressive (AR) method.
- To acquaint the student with basics of electrocardiography in digital image processing.
- Provide students the insight useful for understanding of Direct ECG data compression techniques and Transformation compression techniques.
- To acquaint the student with the concepts of various VLSI tools.

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Understanding the basic ideas of DFT and FFT algorithms.
- Gain knowledge in D\different types of wavelet transforms & their characteristics.
- Discuss the EEG signal and its characteristics in Neurological signal processing.
- Clear idea about the use of multiscale analysis for parameters estimation of ECG waveforms.
- Acquire the knowledge Direct data compression techniques and Transformation compression technique.

UNIT I INTRODUCTION TO WAVELET TRANSFORMS 12

Basics of FT,FFT, DTFT, DFT, DIT-FFT, DIF-FFT algorithms, Introduction to wavelet transforms, Advantages, Applications, Limitations, Different types of wavelet transforms & their characteristics, The Discrete Wavelet Series, The Discrete Wavelet Transform, Multi Resolution Analysis.

UNIT II NEUROLOGICAL SIGNAL PROCESSING 12

The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination.

UNIT III CARDIOLOGICAL SIGNAL PROCESSING 12

Basic electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, the use of multiscale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis monitoring, Long-term continuous ECG is recording.

UNIT IV ADAPTIVE FILTERS & ECG DATA REDUCTION TECHNIQUES 12

Principal noise canceller model, 60- Hz adaptive canceling using a sine wave model, applications of adaptive filtering, Direct data compression techniques, Direct ECG data compression techniques, Transformation compression technique

UNIT V VLSI IN DSP **12**

Digital signal processors. High performance VLSI signal processing, VLSI applications in medicine, VLSI sensors for biomedical signals, VLSI tools, choice of custom, ASIC, or off- the- shelf components

TOTAL:60

SUGGESTED READINGS:

1. D.C. Reddy (2005)Biomedical Signal Processing, Principles and Techniques , Tata McGraw Hill,.
2. Wills J. Tompkins,(2007) “Biomedical digital signal processing”, Prentice Hall of India Pvt. Ltd.

24RECE315 PAPER III-SPECIAL PAPER VIII : PATTERN RECOGNITION 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student acquire sound knowledge of fundamentals of mathematical preliminaries.
- To familiarize the student with Single and Multilayer perceptron methods.
- To imparts a good knowledge about single linkage and complete linkage clustering.
- To acquaint the student with branch and bound algorithm and sequential forward/backward selection algorithms for feature selection.
- Provide students the insight useful for understanding visualization of datasets and existence of unique clusters or no clusters.

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Acquire the knowledge of probability theory, estimation techniques.
- Understanding the ideas of Linear discriminant functions and Non-linear decision boundaries.
- Gain knowledge in different distance functions and similarity measures in clustering.
- Discuss the Probabilistic separability-based criterion functions and interclass distance-based criterion functions.
- Clear idea about the sequential forward/backward selection algorithms.

UNIT I – INTRODUCTION 12

Introduction and mathematical preliminaries What is pattern recognition, Clustering vs. Classification; Applications; Linear Algebra, vector spaces, probability theory, estimation techniques.

UNIT II – CLASSIFICATION 12

Bayes decision rule, Error probability, Error rate, Minimum distance classifier, Mahalanobis distance; K-NN Classifier, Linear discriminant functions and Non-linear decision boundaries. Fisher's LDA, Single and Multilayer perceptron, training set and test sets, standardization and normalization.

UNIT III – CLUSTERING 12

Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means clustering, single linkage and complete linkage clustering, MST, medoids, DBSCAN, Visualization of datasets, existence of unique clusters or no clusters.

UNIT IV - FEATURE SELECTION 12

Problem statement and Uses, Probabilistic separability based criterion functions, interclass distance based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms, (l,r) algorithm.

UNIT V - FEATURE EXTRACTION **12**

Principal component analysis, Kernel PCA. Recent advances in Pattern recognition: Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy.

TOTAL:60

SUGGESTED READINGS:

1. R.O.Duda, P.E.Hart and D.G.Stork, (2001.)Pattern Classification, John Wiley.
2. K. Fukunaga(2000); . Statistical pattern Recognition ,Academic Press,.
3. S.Theodoridis and K.Koutroumbas,(2009) Pattern Recognition, 4th Ed., Academic Press,.

24RECE316 PAPER III-SPECIAL PAPER IX : DESIGN OF ANALOG AND MIXED MODE VLSI CIRCUITS 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks: External 100 Total 100

End semester Exam: 3Hrs

COURSE OBJECTIVES:

The goal of this course for research scholars is:

- To make the student acquire sound knowledge of MOS devices and its characteristics.
- To familiarize the student with single ended and differential operation in single stage amplifiers
- To imparts a good knowledge about phase locked loops and delay locked loops.
- To acquaint the student with passive and active current mirrors.
- Provide students the insight useful for understanding of phase locked loops in Operational amplifiers.

COURSE OUTCOMES:

At the end of the course the research scholars will be able to :

- Gain knowledge in basic MOS Devices and its models.
- Discuss the differential pair with MOS loads.
- Clear idea about the common-gate stage and Cascade Stage amplifier.
- Acquire the knowledge phase locked loops and its applications.
- Understanding of the ideas of passive and active current mirrors.

UNIT-1 INTRODUCTION 12

Basic MOS Device Physics: General considerations, MOS I/V Characteristics, second order effects, MOS device models.

Single stage Amplifier: Basic Concepts, Common Source stage.

UNIT –II SINGLE STAGE AMPLIFIER 12

Source follower, common-gate stage, Cascode Stage, choice of device models.

Differential Amplifiers: Single ended and differential operation, Basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

UNIT III PASSIVE AND ACTIVE CURRENT MIRRORS 12

Basic current mirrors, Cascode Current mirrors, Active Current mirrors. Operational Amplifiers (part-1): General Considerations, One Stage OP-Amp, Two Stage OP-Amp, Gain boosting.

UNIT IV OPERATIONAL AMPLIFIERS (PART-2) 12

Common Mode Feedback, Slew rate, Power Supply Rejection.

Phase Locked Loops: Simple PLL, Charge pump PLLs, Non-ideal effects in PLLs, Delay-Locked Loops, Applications. (Text 1)

UNIT V DATA CONVERTER ARCHITECTURES **12**

DAC & ADC Specifications, Current Steering DAC, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. (Text 2)

TOTAL:60

SUGGESTED READINGS:

1. Behzad Razavi, ―Design of Analog CMOS Integrated Circuits‖, TMH, 2007.
2. R. Jacob Baker, ―CMOS Circuit Design, Layout, and Simulation‖, Second Edition, Wiley.
3. Phillip E. Allen, Douglas R. Holberg, ―CMOS Analog Circuit Design‖, Second Edition, Oxford University Press.