Ph.D (Electrical and Electronics Engineering)

Course Work: Curriculum and Syllabi

2024 - 2025

Department of Electrical and Electronics Engineering

Faculty of Engineering

Enable | Enlighten | Enrich

KARPAGAM

ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

KARPAGAM ACADEMY OF HIGHER EDUCATION

Faculty of Engineering

Department of Electrical and Electronics Engineering

(Deemed University Established Under Section 3of UGCAct1956)

Pollachi Main Road, Eachanari Post, Coimbatore- 641021, 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, 2023 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.

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

16.2Condition for submission of thesis:

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

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

17.0 Pre-Submission Presentation

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

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

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

18.0. Plagiarism (Turnitin Software):

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

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

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

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

19.0. Submission of synopsis

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

19.1 Submission of thesis

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

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

20.0 Evaluation of the Thesis

20.1 The Ph.D. thesis submitted by a Ph.D. scholar shall be evaluated by his/her Research Supervisor and atleast two external examiners who are experts in the field. Such examiner(s) should be academics with a good record of scholarly publications in the field. Wherever possible, one of the external examiners should be chosen from outside India. The viva-voce board shall consist of the Research Supervisor and at least one of the two external examiners and may be conducted offline.

20.2 The viva-voce of the Ph.D. scholar to defend the thesis shall be conducted if both the external examiners recommend acceptance of the thesis after incorporating any corrections suggested by them. If one of the external examiners recommends rejection, the Institution concerned shall send the thesis to an alternate external examiner from the approved panel of examiners, and the viva-voce examination shall be held only if the alternate examiner recommends acceptance of the thesis. If the alternate examiner does not recommend acceptance of the thesis, the thesis shall be rejected, and the Ph.D. scholar shall be declared ineligible for the award of a Ph.D.

20.3 Each member of the Board shall adjudicate the thesis and shall submit a detailed report as given in the prescribed form on the merits and demerits of the thesis and finally explicitly indicate whether the thesis is Recommended or Recommended for Resubmission or Not Recommended within a period of 6 months.

20.4 If the evaluation report from the examiner is not received within 6 Months, another examiner will be appointed from the panel of examiners.

20.5 As soon as the reports of evaluation are received from the examiners by Controller of Examinations, they shall be sent to the Research Supervisor (Convener) for consolidation of the reports.

20.6 If the examiners insist on corrections to be made in the thesis, the same shall be made before appearing for the Public viva-voce examination, along with a certificate as given below from the Research Supervisor that the corrections have been satisfactorily carried out.

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

CERTIFICATE

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

Signature of the Research Supervisor

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

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

20.8 The time-limit to resubmit the revised thesis, as per the suggestions for revision and resubmission of thesis by the examiner(s) shall not exceed twelve full months. A candidate shall not ordinarily be permitted to submit the thesis for the degree or to take the public viva-voce examination on more than two occasions.

20.9 The viva-voce shall be conducted by the Research Supervisor and atleast by one of the two external examiners, on the critiques given in the evaluation report. It is open to DC Members, all faculty members, research scholars and other interested experts/researchers.

20.10 The first notification for Ph.D., viva-voce shall be issued only after the Research Supervisor of the candidate, receives the approval from the authorities to issue the first notice.

20.11 15 clear days' notice may be required to be given for issue of the second notification from the date of the first notification. Similarly, 15 clear days are required to be given for conducting the public viva-voce from the date of issue of the second notification.

20.12 The Research Supervisor shall fix the date and time of the viva-voce in consultation with the External Examiner and Head of the Department concerned. After conducting the public viva-voce, the Research Supervisor shall convey to the Controller of Examination, the result of such examination endorsed by the External Examiner along with list of participants, recommending for the award of Ph.D.,

20.13 A candidate who is not successful in the Public viva-voce may be permitted to undergo the Public viva-voce second time, within a period of three months but not before one month after the first viva-voce.

20.14 The entire process of evaluating a Ph. D. thesis, including the declaration of the viva-voce result, within a period of six (6)months from the date of submission of the thesis.

21.0 Award of the Degree

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

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

Award of Ph.D. degrees:

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

Depository with INFLIBNET:

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

22.0. Cancellation of Registration

The registration of a research scholar shall stand cancelled if -

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

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

23.0. Publication of the thesis

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

[**CERTIFICATE**]

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

Signature of the Research Supervisor

24.0. Conferment of the Degree

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

25. Preparation and Submission of Synopsis and Thesis

25.1 Preparation of Synopsis

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

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

Top edge: 30 mm Bottom edge: 30 mm
Left side: 35 mm Right side : 25 mm

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

References

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

a. Single author

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

b. Two authors

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

c. More than two authors

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

II. References cited from a published book

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

III. References cited from approved Thesis / Dissertation

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

25.2 Preparation of Thesis

A. General

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

B. Size of Thesis

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

C. Sequence of the Contents of the Thesis

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

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

D. Page Dimensions and Margin

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

E. Bonafide Certificate

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

F. Acknowledgement

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

G. Table of Contents

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

H. List of Symbols and Abbreviations

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

I. Abstract

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

J. Chapters

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

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

K. List of References

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

L. Appendices

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

M. List of Publications

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

N. Tables and Figures

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

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

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

O. Typing Instructions

General

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

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

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

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

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

P. Page Numbering

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

Q. Numbering of Chapters, Divisions and Sub-Divisions

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

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

R. Numbering of Tables and Figures

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

S. Numbering of Equations

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

T. Binding Specifications

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

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

Revision of Regulation:

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

TEMPLATE

ANNEXURE I

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

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

SYNOPSIS
<Font Size 14>

Submitted by
<Font Size 14><Italic>

RAGHAVENDRA S A
<Font Size 16>

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

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

Enable | Enlighten | Enrich
KARPAGAM
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(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 IV

Specimen of Declaration

<Font Style Times New Roman>

DECLARATION

<Font Size 16>

<Font Size 12>

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

Signature of the Research Scholar

ANNEXURE V

Specimen of Certificate

<Font Style Times New Roman>

CERTIFICATE

<Font Size 16>

<Font Size 12>

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

Countersigned
Head of the Department **Signature of the Research Supervisor**

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

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

FORMAT I

Progress Report of Research Scholar

(To be submitted once in six months)

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

No.	Month	Year

6. Brief report about the work carried out by the Research scholar :
   a. Article/s published _____No's (Attach copies)
   b. Seminars/Conferences attended _____ (Attach certificate copies)
   c. Course work: Completed / Not Completed (Attach copy of Mark sheet)
   d. Course fee: Paid till _____ (copies of receipts)

7. Research Guide's Comment :

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

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

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FORMAT II

Request for Pre-submission presentation

Check list

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

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

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

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FORMAT III

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

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

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

Ph.D. Thesis Title: "_____".

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

Venue :
Date :
Time :

Registrar

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

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

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FORMAT - IV

DEPARTMENT OF _____

Pre-submission Presentation Report

Date:

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

Signature:

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

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

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FORMAT – IV Annexure

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

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

Topic of the Research work:

Q1.
Answer:

Q2.
Answer:

Q3.
Answer:

Q4.
Answer:

Q5:
Answer:

Signature of

Research Scholar **Research Supervisor**

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FORMAT V

Pre-submission presentation
Certificate

Name & Reg. No. of the research scholar :

Subject :

Date of Presentation :

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

Place :
Date :

Signature of the Research Supervisor
(Name & Address)

Counter Signed:

HOD
(Name & Seal)

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

FORMAT - VI

Submission of Ph.D., Thesis: Check List

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

Signature of:

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

For Office of the Research use:

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

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

Addl. Director, Research **Director, Research**

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

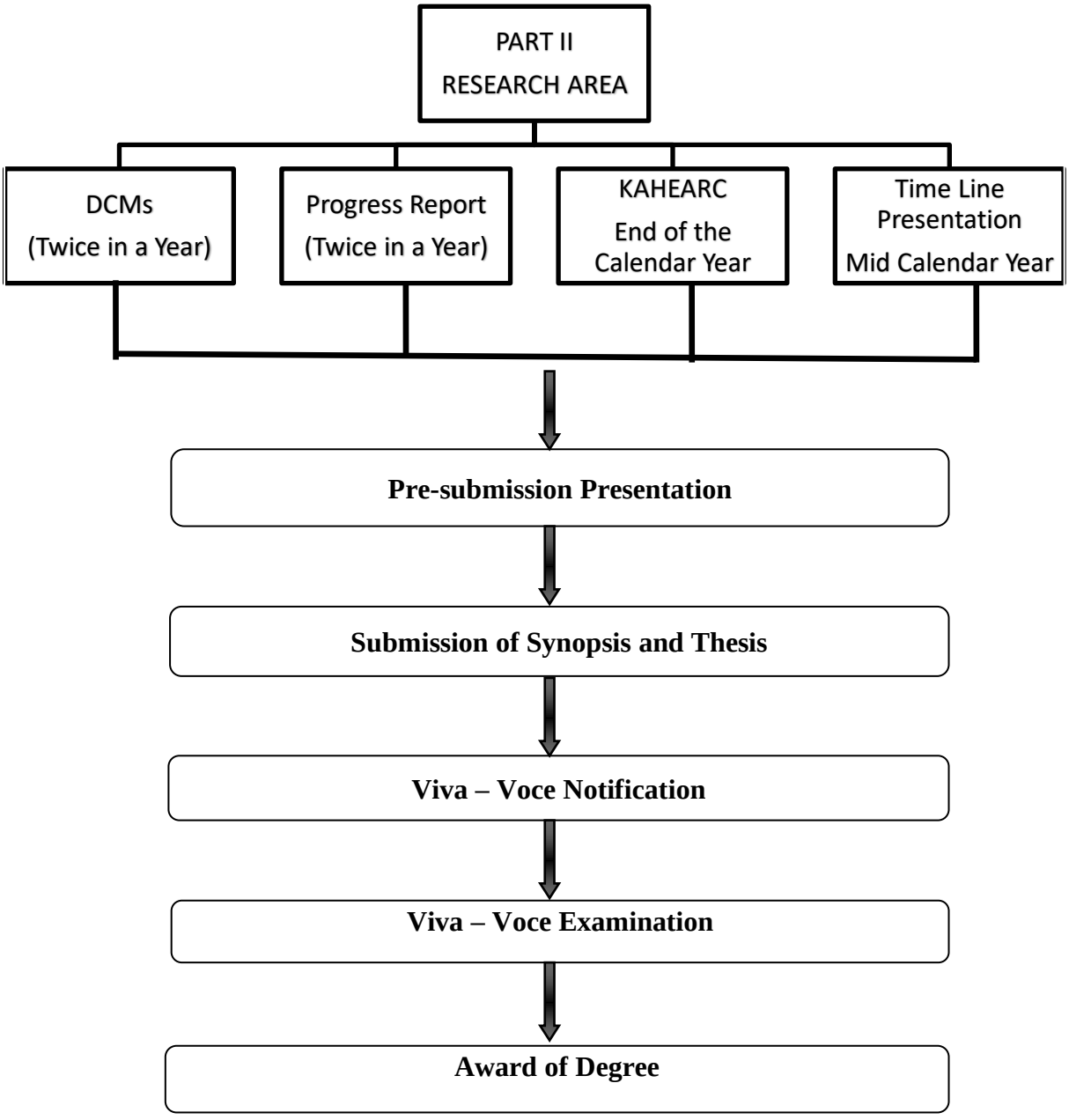
Certificate of Plagiarism

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

Signature of the Research Scholar

Signature of the Research Supervisor

Professor in- charge for Plagiarism Test


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

Publications terminology

1. Impact Factor

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

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

Calculation

Example: If a Journal has an impact factor of 3 in the year 2022; it means that each paper published in that journal during the years 2020 and 2021 had received an average of 3 citations in 2008.

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

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

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

2. HIndex

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

3. Scopus

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

SciVerse

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

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

4. International Standard Serial Number

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

Code format

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

Code assignment

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

Availability

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

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

5. Peer Review

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

Professional peer review

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

Scholarly peer review

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

6. Web of Science

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

7.Science Citation Index

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

8. International Standard Book Number

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

ISBN issuance

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

PhD Course Work Subjects
(Effective from the academic year 2024-2025 onwards)

Paper No.	Subject Code	Subject	Credit	ESE	total
Paper 1	24REEE101	Research Methodology and Pedagogy	4	100	100
Paper II	24REEE201	Research and Publication Ethics	4	100	100
Paper III	24REEE301	Renewable Energy Sources	4	100	100
	24REEE302	Advances in Power Electronics	4	100	100
	24REEE303	Advances in Power Systems	4	100	100
	24REEE304	Distributed Generation	4	100	100
	24REEE305	Smart Grids	4	100	100
	24REEE306	Advanced Control Systems	4	100	100
	24REEE307	Analysis of Inverter Circuits	4	100	100
	24REEE308	Analysis of Converter Circuits	4	100	100
	24REEE309	Power Quality Assessment &Mitigation	4	100	100
	24REEE310	Computer Aided Design of Electrical Apparatus	4	100	100
	24REEE311	Energy Auditing, Energy Efficiency and Energy Conversion	4	100	100
	24REEE312	Power Electronics Applications to Power Systems	4	100	100
	24REEE313	Special Electrical Machines	4	100	100
	24REEE314	Advanced Bio-Medical Digital Signal Processing	4	100	100
	24REEE315	Power Sector Economics, Management and Restructuring	4	100	100
	24REEE316	Wind Energy Conversion Systems	4	100	100
	24REEE317	Theory and Design of Neuro-Fuzzy Controllers	4	100	100
	24REEE318	Soft Computing Techniques	4	100	100
	24REEE319	Flexible AC Transmission Systems	4	100	100
	24REEE320	HVDC Systems	4	100	100
	24REEE321	Digital Power System Protection	4	100	100
	24REEE323	Optimization Techniques	4	100	100
	24REEE323	Embedded Systems	4	100	100
	24REEE324	Artificial Intelligence Applications to Power Systems	4	100	100

Part I - Ph.D - Syllabus
Paper I: 24REEE101 RESEARCH METHODOLOGY AND PEDAGOGY
(Effective from the academic year 2024-2025 onwards)

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY

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

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 – Relevance, limitations and cautions.

UNIT III HYPOTHESES TESTS

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 PARAMETRIC TESTS AND REPORT WRITING

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 VPEDAGOGICAL 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

TEXT BOOKS:

- Rajasekar.S (2005) Computer Education and educational computing. Hyderabad: Neel kamal Publications.
- Kumar K.L. (1997) Educational Technologies, New Delhi: New age International.
- Vedanayagam, E.G (1989) Teaching Technology for college teachers. New Delhi: Sterling Publishers (P) Ltd.,

REFERENCES:

- Kothari C.R. Research Methodology Methods and Techniques, New Age Publications, Second edition,2009
- Panneer selvam R., Research Methodology, Prentice-Hall of India, New Delhi,2004

Paper II: 24REEE201 RESEARCH AND PUBLICTION ETHICS
(Effective from the academic year 2024-2025 onwards)

UNIT I PHILOSOPHY AND ETHICS (3 HRS)

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

Unit II SCIENTIFIC CONDUCT (5 HRS)

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

UNIT III PUBLICATION ETHICS (7 HRS)

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

UNIT – III OPEN ACCESS PUBLISHING (4 HRS)

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

UNIT IV PUBLICATION MISCONDUCT (4 HRS)

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

UNIT V - DATABASES AND RESEARCH METRICS (7 HRS)

Databases: Indexing databases - Citation databases: Web of Science, Scopus, etc.

Research Metrics: Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 index, altmetrics

UNIT VI Development of e-content & IPR

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

IPR: Patent – copyrights – Trademark – Geographical Indication.

PRACTICE

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

Paper III: 24REEE301 RENEWABLE ENERGY SOURCES
(Effective from the academic year 2024-2025 onwards)

UNIT – I SOLAR ENERGY

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storages.

UNIT – II WIND ENERGY

Introduction – Basic principles of wind energy conversion – wind data and energy estimation – site selection consideration – basic components of wind energy conversion system –Types of wind machines – basic components of wind electric conversion systems. Schemes for electric generations – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT – III CHEMICAL ENERGY SOURCES

Introduction – fuel cells – design and principles of operation of a fuel cell –
Classification of fuel cells. Types of fuel cells – conversion efficiency of fuel cells. Types of electrodes, work output and emf of fuel cell, Applications of fuel cells. Hydrogen energy: Introduction – hydrogen production – electrolysis, thermo chemical methods, Westing House Electro-chemical thermal sulphur cycle. Fossil fuel methods. Hydrogen storage, Utilization of hydrogen gas.

UNIT – IV ENERGY FROM OCEANS

Introduction, ocean thermal electric conversion (OTEC), methods of ocean thermal electric power generation, open cycle OTEC system, closed OTEC cycle. Energy from tides: Basic principles of tidal power, component of tidal power plants, operation methods of utilization of tidal energy, site requirements, storage, advantages and limitations of tidal power generation. Ocean waves, energy and power from the waves, wave energy conversion devices.

UNIT – V GEOTHERMAL ENERGY

Introduction, estimation of geothermal power, nature of geothermal fields, Geothermal sources, inter connection of geothermal fossil systems, prime movers for geo thermal energy conversion. Application of geothermal energy. Energy from biomass: Introduction, Biomass conversion technologies, photosynthesis, classification of biogas plants. Biomass Energy conversion, Energy from waste.

TEXT BOOKS:

- Goswami, D.Y., Kreith, F., and Kreider, J.F., 2000, Principles of Solar Engineering, Taylor and Francis, Philadelphia.
- Duffie, J.A., and Beckman, W.A., 1991, Solar Engineering of Thermal Processes, 2nd Edition, John Wiley, New York.

REFERENCES

- Rai, G.D., Non-Conventional Energy Sources. Khanna publishers, Fourth edition,2010
- Twidell, J., and Weir, T., 2006, Renewable Energy Resources, E&FN Spon Ltd., London.
- Sukatme, S.P., 1991, Solar Energy – Principles of thermal collection and storage, 2nd Edition, Tata Mc Graw Hill, New Delhi.

Paper III: 24REEE302ADVANCES IN POWER ELECTRONICS
(Effective from the academic year 2024-2025 onwards)

UNIT-I RESONANT CONVERTERS

Zero voltage and zero current switching-Classification of resonant converters-Basic resonant circuit concepts-Load resonant converters-Resonant switch converters-Zero voltage switching, clamped voltage topologies-Resonant DC link inverters and zero voltage switching- High frequency link integral half cycle converters – Applications in SMPS and lighting.

UNIT-II IMPROVED UTILITY INTERFACE

Generation of current harmonics – Current harmonics and power factor-Harmonic standards and recommended Practices-Need for improved utility interface-Improved single phase utility interface- Improved three phase utility interface – Electromagnetic interference

UNIT-III FACTS

Introduction – Principles of reactive power control in load and transmission line Compensation-Series and shunt reactive power compensation – Concepts of flexible AC Transmission system(FACTS) –Static var compensators(SVC)-Thyristor controlled reactor-Thyristor switched capacitor –Solid state power control-Static condensers-Controllable series compensation-Thyristor controlled phase angle regulator and unified power flow control.

UNIT-IV MODELING AND ANALYSIS

Modeling and methods of analysis of SVC and FACTS controllers – System control and protection –Harmonics and Filters –Simulation and study of SVC and FACTS under dynamic conditions.

UNIT-V EMERGING DEVICES AND CIRCUITS

Power Junction Field Effect Transistors-Field Controlled Thyristors-JFET based devices Vs other power devices-MOS controlled thyristors-Power Integrated Circuits-New semiconductor materials for power devices.

TEXT BOOKS:

- Bimal k Bose, “Modern Power Electronics-Evolution, Technology and application”, Jaico Publishing House, Mumbai, 2006
- Ned Mohan., Undeland and Robbins,” Power Electronics: Convertors, Applications and Design”, John Wiley and Sons(Asia) Pte Ltd, Singapore, 2003.

REFERENCES

- Rashid, M.H., “Power Electronics-Circuits, Devices and Applications”, Pearson Education(Singapore)Pte. Ltd, New Delhi, 2004./Prentice Hall of India, New Delhi.
- Mohan Mathur P, Rajiv K Varma, “Thyristor- Based Facts Controllers for Electrical Transmission Systems”, John Wiley and Sons Inc., IEEE Press, UAS, 2002.
- Roger C Durgan, Maric F Mcgranaghan, “Electrical Power System Quality”, Mc-Graw Hill Inc, New York ,1996.
- Joseph Vithayathil., “Power Electronics”, Mc-Graw Hill series in Electrical and Computer Engineering, USA, 1995.

Paper III: 24REEE303ADVANCES IN POWER SYSTEMS
(Effective from the academic year 2024-2025 onwards)

UNIT-I ECONOMIC DISPATCH

Planning and operational problems of power systems - review of economic dispatch and calculation using B matrix loss formula - Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration Method-Base point and participation factors in on line economic dispatch. Economic dispatch controller added to LFC control.

UNIT-II REAL POWER AND REACTIVE POWER

Fundamentals of speed governing mechanism and modeling- Speed-load characteristics – Load sharing between two synchronous machines in parallel - Plant and system level control problem - ALFC of single area system - modelling-static and transient response - ALFC of multi area system-modelling - static and transient response of two area system - development of state variable model -Two area system- AGC system design Kalmans method. Modeling of AVR loop -components - dynamic and static analysis - stability compensation - system level voltage control using OLTC, capacitor and generator voltages -expert system application for system voltage control.

UNIT-III VOLTAGE STABILITY ANALYSIS-I

Transmission and generation and load aspects. Instability mechanisms and analysis methods: mathematical background -differential equations, bifurcations, multiple time scales.

UNIT-IV VOLTAGE STABILITY ANALYSIS-II

Modeling for voltage stability analysis: time scale decomposition Equilibrium equations for voltage stability analysis. Loadability, sensitivity and bifurcation analysis-eigenvector and singular vector properties-loadability or bifurcation surface-case studies short term and long term voltage instability and counter measures.

UNIT-V SOLUTIONS METHODS AND MODELS FOR ANALYSIS OFELECTROMAGNETIC TRANSIENTS

Steady state and time step solutions in EMTP and their uses-models of synchronous, and induction machines EMTP; Selected case studies.

TEXT BOOKS:

- Allen J Wood and Bruce F Wollenberg, 2013, Power generation and control, John Wiley and sons, New York.
- Kundur, P., 2008 , Power system stability and control, EPRI publications, California.

REFERENCES

- Cutsem,T.V., Vournas, C., 1998,Voltage stability of power systems, Kluwer Academic Publishers.
- Dommel, H.W., August 1986, Electromagnetic Transients Program, Reference Mannual prepared for Bonnerville Power Administration, U.S.A..

Paper III: 24REEE304DISTRIBUTED GENERATION
(Effective from the academic year 2024-2025 onwards)

UNIT I INTRODUCTION TO DISTRIBUTED GENERATION

Introduction to the concept of distributed generation - Distributed generation advantages and needs - Radial distribution system protection: Fuse, circuit breakers, reclosers- Per-unit analysis, fault analysis, sequence component analysis, sequence models of distribution system components. Implications of DG on distribution system protection coordination.

UNIT II DISTRIBUTION SYSTEM LOADING

Introduction – Distribution system loading, line drop model, series voltage regulators and on line tap changers- Power quality requirements and source switching using SCR based static switches- Loop and secondary network distribution grids and impact of DG operation.

UNIT III RELAYING AND PROTECTION

Relaying and protection, distributed generation interconnection relaying, sensing using CTs and PTs- Intentional and unintentional islanding of distribution systems. Passive and active detection of unintentional islands, non-detection zones - EMI considerations in DG applications.

UNIT IV DISTRIBUTED GENERATION PLANNING

DG planning and forecasting techniques - Load characteristics: Definitions - tariffs and metering of energy, cost implications of power quality, cost of energy and net present value calculations and implications on power converter design- Distribution Transformers: Types. Distribution sub-stations and primary systems: Voltage drop and power loss calculations: Distribution feeder costs.

UNIT V DG INVERTERS CONTROL

Control of DG inverters, phase locked loops, current control and DC voltage control for standalone and grid parallel operations. Protection of the converter.

TEXT BOOKS

- A Textbook of Electric Power Distribution Automation by Dr. M.K. Khedkar, Dr. G.M. Dhole Laxmi Publications, Ltd 2010.

REFERENCES

- Power Electronics: Converters, Applications, and Design by Ned Mohan, Tore M. Undeland, William P. Robbins Wiley,2002
- Electric Power Distribution Systems by TuranGonen, CRC Press, 2006
- Electric Power Distribution by Pabla, A. S 6th Edition, Tata McGraw-Hill Education 2011

Paper III: 24REEE305 SMART GRIDS
(Effective from the academic year 2024-2025 onwards)

UNIT I INTRODUCTION: SMART GRID AND EMERGING TECHNOLOGIES

Defining a smart grid – Characteristics of smart grid - Values of a smart grid – The economic Case – The environmental Case – Benefits to utilities – Benefits to consumers – Power system components – Power system protection: Traditional Vs Smart – Case study – Generation fundamentals – Traditional Generations – Distributed Generations – micro grid generation – Generator Protection – Challenges and Opportunities – Cost of smart grid – Government Regulations – Emerging Technologies - FACTS – optimizing integration systems – Multi generation buildings – Case study.

UNIT II SMART GRID: MODELS AND OPERATING PRINCIPLES

Solar Photovoltaic models and grid Integration – Design of a 2 MVA PV station – DG system as part of utility power system – The smart grid PV - UPS DG system – Split DC Bus UPS – PV DG system – Island mode of operation – Parallel operation of Inverters – Power Quality. Wind turbine model and grid Integration – Micro turbine model & Grid Integration. Electric Vehicle model and Grid Integration.

UNIT III SMART GRID: DISTRIBUTED GENERATION SYSTEMS

Power Converter System – Control System Development – Current limit and Saturation Control, Simulation using simulate and MATLAB. Inverter Parallel operation – Load sharing control Algorithm – Distributed Generation System and Newton Raphson method in power flow – Plant modeling and 3 phase 4 wire DG unit topology – Single distributed generation System –MIMO Linear system Stability robustness – PWM rectifier control – 3 Phase AC – DC – AC topology.

UNIT IV ENERGY STORAGE AND COMMUNICATION

State–of–the art storage devices – Battery types – Ultra capacitors based Energy Storage System – Flywheel – Wide Area Network – Substation Information System – Wireless Networks – Distribution Automation – AMI Networks – Utility monitoring and Control – Inter-system Coordination – Industrial systems – Consumer Residential Systems – Network Protection – Channel model Fundamental – Low, medium, High voltage, main Topologies – Residential and Business Indoor wiring Topologies – The Power line Channel model – Digital Transmission Techniques - Threats – IEC61850 Considerations.

UNIT V SMART GRID: RELIABILITY, STABILITY AND COMPONENT INTEGRATION

Smart Grid Programming – Virtual Power Producer – Intelligent reconfiguration using SCADA – Problems in distributed grids – Solutions. Integration of Mini – Micro generation in distribution Grids – Power supply Quality generic standards – Renewable Energies specific standards – Smart Grid stability analysis schemes – Supply guarantee and Power quality – Integration in power systems – Distributed Generation advantages and needs.

REFERENCES

- Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities by Fox-Penner Island Press, Washington DC 2010
- Smart Grid: Modernizing Electric Power Transmission and Distribution; Energy Independence, Storage and Security; Energy Independence and Security Act and Resiliency by StanMark Kaplan, Fred SissineThe Capitol.Net, Washington DC,2009
- Integration of Green and Renewable Energy in Electric Power Systems by Ali Keyhani Mohammad N. Marwali , Min Dai Wiley, USA ,2009
- Power Electronics in Smart Electrical Energy Networks by Ryszard Michal Strzelecki , Grzegorz Pawel Benysek Springer, USA 2008

Paper III: 24REEE306 ADVANCED CONTROL SYSTEMS
(Effective from the academic year 2024-2025 onwards)
ADVANCED CONTROL SYSTEMS

UNIT 1 STATE VARIABLE ANALYSIS

Concept of state – State Variable and State Model – State models for linear and continuous time systems – Solution of state and output equation – controllability and observability - Pole Placement –State observer Design of Control Systems with observers

UNIT II PHASE PLANE AND DESCRIBING FUNCTION ANALYSIS

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Construction of phase portraits – Singular points – Limit cycles Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

UNIT III Z-TRANSFORM AND DIGITAL CONTROL SYSTEM

Z transfer function – Block diagram – Signal flow graph – Discrete root locus – Bode plot.

UNIT 1V STATE-SPACE DESIGN OF DIGITAL CONTROL SYSTEM

State equation – Solutions – Realization – Controllability – Observability – Stability – Jury's test.

UNIT V OPTIMAL CONTROL

Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control Optimal estimation – Multivariable control design.

TEXT BOOKS

- Control Systems Engineering By I.J. Nagrath and M. Gopal New Age International Publishers – 4th edition 2006
- Modern control Design with Matlab and Simulink by Ashish Tewari John Wiley, New Delhi 2002
- Digital Control Systems by Benjamin C. Kuo Oxford University Press – 2nd edition,2012.

REFERENCES

- Modern control system theory by M.Gopal New Age International Publishers,2002
- Feedback Control of Dynamic Systems by Gene F. Franklin, J. David Powell and Abbasemami-NaeiniPrentice Hall, 7th edition,2014
- Design of feedback Control systems by Raymond T. Stefani & Co Oxford University Press,2002

Special Paper III: 24REEE307 ANALYSIS OF INVERTER CIRCUITS
(Effective from the academic year 2024-2025 onwards)

UNIT- I SINGLE PHASE INVERTERS

Principle of operation of half and full bridge inverters – Performance parameters – Voltage and wave form control of single phase inverters using various PWM techniques – SVM Technique.

UNIT- II THREE PHASE VOLTAGE SOURCE INVERTERS

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage and wave form control of three phase inverters –SVM Technique.

UNIT- III CURRENT SOURCE INVERTERS

Operation of six-step thyristors inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters.

UNIT- IV MULTILEVEL INVERTERS

Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - comparison of multilevel inverters - application of multilevel inverters.

UNIT- V RESONANT INVERTERS

Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters.

TEXT BOOKS

- Rashid, M.H., 2004, Power Electronics Circuits, Devices and Applications, 3rd Edition, Prentice Hall of India, New Delhi.
- Jai P Agrawal, 2002, Power Electronics Systems, Pearson Education, 2nd Edition.
- Ned Mohan, Undeland and Robins, 1995, Power Electronics: converters, Application and design, John Wiley and sons Inc, Newyork.

REFERENCES

- Sen, P.C. 1998, Modern Power Electronics, 1st Edition, Wheeler Publishing Co, New Delhi.
- Bimbra, P.S., 2003, Power Electronics, 11th Edition, Khanna Publishers.
- Bimal K Bose, 2003, Modern Power Electronics and AC Drives, 2nd Edition, Pearson Education.
- Singh, M.D., Khanchandan, K.B., 2002, Power Electronics, Tata McGraw Hill Publishing Limited, New Delhi.

Special Paper III: 24REEE308 ANALYSIS OF CONVERTER CIRCUITS
(Effective from the academic year 2024-2025 onwards)

UNIT- I SINGLE PHASE AC-DC CONVERTER

Uncontrolled, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation – Dual converter - Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap.

UNIT -II THREE PHASE AC-DC CONVERTER

Uncontrolled and fully controlled – converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – dual Converter – performance parameters – effect of source impedance and overlap.

UNIT- III DC-DC CONVERTERS

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters – time ratio and current limit control – Full bridge converter – Resonant and quasi – resonant converters.

UNIT- IV AC VOLTAGE CONTROLLERS

Principle of phase control: single phase and three phase controllers – various configurations – analysis with R and R-L loads.

UNIT- V CYCLOCONVERTERS

Principle of operation – Single phase and three phase cycloconverters – power circuits – Output Voltage control – Control Schemes.

TEXT BOOKS

- Ned Mohan, Undeland and RoMEPEin, 2007, Power Electronics: converters, Application and design, John Wiley and sons.Inc, Newyork.

- Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall of India, New Delhi, 1995.

REFERENCES

- Bimbra, P.S., 2003, Power Electronics, 11th Edition, Khanna Publishers.

- Dubey, G.K.,Doradla, S R., Joshi, A., Sinha, R.M K., 2004, Thyristorised Power Controllers, 1st Edition, New Age International Private Ltd.

Special Paper IIII: 24REEE309 POWER QUALITY ASSESSMENT AND MITIGATION
(Effective from the academic year 2024-2025 onwards)

UNIT- I INTRODUCTION

Importance of power quality, terms and definitions of power quality as per IEEE std. 1159. such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding.

UNIT- II FLICKERS AND TRANSIENT VOLTAGES

RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Various means to reduce flickers. Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

UNIT- III VOLTAGE SAG, SWELLS AND INTERRUPTIONS

Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag. Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of fault location and fault level on voltage sag. Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag *limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions.

UNIT- IV WAVEFORM DISTORTION

Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effect of harmonics. Voltage versus current distortion. Overview of Fourier analysis. Harmonic indices. A.C. quantities under non-sinusoidal conditions. Triplen harmonics, characteristics and non-characteristics harmonics. Harmonics series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. Modifying the system frequency response. IEEE Harmonic standard 519-1992.

UNIT -V POWER QUALITY MONITORING, ASSESSMENT AND MITIGATION

Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors,
data collection and analysis. Selection of transducers. Harmonic monitoring, transient monitoring, event recording and flicker monitoring.
Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion, voltage and current unbalances. Power assessment under waveform distortion conditions. Power quality state estimation, State variable model, observability analysis, capabilities of harmonic state estimation. Test systems. Mitigation techniques at different environments.

TEXT BOOKS

- M. H. J. Bollen IEEE press, 2000, Understanding power quality problems, voltage sag and interruptions - series on power engineering.
- Roger C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty 2002 ,Electrical power system quality, second edition, McGraw Hill Pub.

Special Paper III24REEE310 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

(Effective from the academic year 2024-2025 onwards)

UNIT- I INTRODUCTION

Conventional design procedures – Limitations – Need for field analysis based design.

UNIT- II MATHEMATICAL FORMULATION OF FIELD PROBLEMS

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in field problems – Inductance- Development of torque/force- Lap lace and Poisson's Equations – Energy functional - Principle of energy conversion.

UNIT - III PHILOSOPHY OF FEM

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT - IV CAD PACKAGES

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.

UNIT- V DESIGN APPLICATIONS

Design of Solenoid Actuator – Induction Motor – Insulators – Power transformer.

TEXT BOOKS

- Salon, S.J., 1995, Finite Element Analysis of Electrical Machines, Kluwer Academic Publishers, London.

- Hoole, S.R.H., 1989, Computer – Aided, Analysis and Design of Electromagnetic Devices, Elsevier, New York, Amsterdam, London.

REFERENCES

- Silvester and Ferrari, P.P., 1983, Finite Elements for Electrical Engineers, CambridgeUniversity press.

- Lowther, D.A., and Silvester, P.P., 1986, Computer Aided Design in Magnetics, Springer verlag, New York.

Special Paper III: 24REEE311 ENERGY AUDITING, ENERGY EFFICIENCY AND ENERGY CONVERSION

(Effective from the academic year 2024-2025 onwards)

UNIT-I INTRODUCTION

Scope of energy management, necessary steps in energy management programme, general principles of energy management, qualities of energy manager, functions of energy manager, language of energy manager.

UNIT-II ENERGY AUDIT AND ENERGY CONSERVATION

Energy surveying and auditing, objectives, uses of energy, energy conservation schemes, energy index, cost index, pie charts, Sankey diagrams, load profiles (histrograms), types of energy audits preliminary energy audit-detailed energy audit, questionnaire, energy audit instruments, energy audit report writing.

Indian energy conservation act-2001, second law of thermodynamics, rules for efficient energy conservation of energy and materials, technologies for energy conservation(reducing demand using alternative supplies, load factor, balancing and energy storage), supply side options, demand side options, maximum demand controller, transmission and distribution side options.

UNIT-III ENERGY EFFICIENT MOTORS AND BOILERS

Constructional details, factors affecting efficiency, losses distribution, soft starters, variable speed drives.

Power Factor: Causes and disadvantages of low power factor, methods to improve power factor.

Energy Efficient lighting: Terminology, cosine law of luminance, types of lamps, characteristics, design of illumination systems, good lighting practice, lighting control, steps for lighting energy conservation.

Boilers: Fuels and combustion, type of boilers, performance evaluation, factors affecting boiler performance, data collection format for boiler performance assessment, case studies.

Steam Distribution System: Steam pipe sizing, proper selection of steam traps, optimum insulation, steam utilization, steam balance-energy saving opportunities.

Furnaces: Types and classification of furnaces, performance evaluation of a typical furnace, general fuel economy measures in furnaces, case studies.

UNIT-IV HEAT RECOVERY SYSTEMS AND COMPRESSED AIR NETWORK

Sources of waste heat, guidelines to identify waste heat, grading of waste heat, feasibility study of waste heat recovery, gas to gas heat recovery, rotary generators, heat pipes, gas to liquid heat recovery, waste heat boilers

Cogeneration: Definition and need, basics of thermodynamic cycles, classification of cogeneration systems, steam turbine, typical heat to power ratio in various industries, operating strategies for cogeneration plant, typical cogeneration performance parameters relative merits of cogeneration systems.

Compressed Air Network: Types of compressors, compressor selection, monitoring performance, specific power consumption, FAD test, capacity control and power consumption, compressed air distribution system, moisture separation.

UNIT-V HVAC (HEATING VENTILATION AND AIR CONDITIONING)

Vapour compression system, vapour absorption system, measurements/field testing, performance evaluation, heat pump, energy efficiency ratios, energy conservation opportunities, case studies.

Cooling Towers: Classification of pumps, centrifugal pump, system characteristics, pump operating point, factors affecting pump performance, pump efficiency, effect of over-sizing the pump, effect of speed variation/impeller diameter change, energy performance and evaluation of pumping system at sites, flow control strategies, meeting the fixed flow reduction, meeting the variable flow reduction.

Fans and Blowers: Types of fans and blowers, fan performance evaluation and efficient system operation, fan performance curves, fan selection, variable loads, flow control methods, energy.

TEXT BOOKS

- LC Witte, PS Schmidt and DR Brown: Industrial Energy Management and Utilization (Hemisphere Publishing corporation, Wasington, 1998).

- W Trinks, MH Mawhinney, RA Shannon, RJ Reed, JR Garvey: Industrial Furnaces, Sixth Edition, (John Wiley &Sons, 2003).

REFERENCES

- JL Threlkeld: Thermal Environmental Engineering, Second Edition (Prentice Hall, 1970).

- YP Abbi and Shashank Jain: Handbook on energy Audit and Environment Management, (TERI Press, 2006).

- WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007).

- George Polimeros: Energy Cogeneration Hand book,(Industrial Press, Inc, New York,1981)

Special Paper III: 24REEE312 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

(Effective from the academic year 2024-2025 onwards)

UNIT-1 INTRODUCTION

High power devices for power system controllers-Characteristics-Converters Configurations for large power control.

UNIT-II SINGLE AND THREE PHASE CONVERTERS

Properties-Current and Voltage harmonics-Effects of source and load impedance-Choice of best circuit for power systems.

UNIT III CONVERTER CONTROL

Gate control-Basic means of control-Control characteristics- Stability of Control –Reactive power control.

UNIT IV HVDC SYSTEMS AND FACTS

Application of converters in HVDC Systems-Static VAR Control-Sources of reactive Power-Harmonics and Filters-Concept of Flexible AC Transmission System-Static VAR compensators-Thyristors controlled reactor – Thyristors switched capacitor- Static Condenser-Controllable series compensation-UPFC-Static Voltage and Phase Angle Regulators-Transient Stability Analysis.

UNIT-V ENERGY CONVERSION SYSTEM

Basic components-Generator control-Harmonics –Power factor improvement-PV Conversion Systems: Different schemes-DC and AC power conditioners- Synchronised operation with grid supply –Harmonic problems.

TEXT BOOKS

- Arrillaga and Watson, “Computer Modelling of Electrical Power Systems, John Wiley, London, 2001.
- NarainG.Hingorani, “Understanding FACTS,” IEEE Press, New York, 2000.

REFERENCES

- E.Acha and VG Agilidis, “Power Electronic Control in Electrical Systems”, Elsevier,2002
- Mukund R. Ptel., Wind and Solar Power Systems, CRC Press, London, 1999.
- Rai, G.D., “Solar Energy Utilization”, Khanna Publishers, New Delhi, 1991.

Special Paper III: 24REEE313 SPECIAL ELECTRICAL MACHINES
(Effective from the academic year 2024-2025 onwards)

UNIT- I SYNCHRONOUS RELUCTANCE MOTORS

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics.

UNIT- II SWITCHED RELUCTANCE MOTORS

Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control Microprocessor based controller.

UNIT- III PERMANENT MAGNET SYNCHRONOUS MOTORS

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes.

UNIT- IV PERMANENT MAGNET BRUSHLESS DC MOTORS

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller.

UNIT- V STEPPING MOTORS

Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

TEXT BOOKS

- Miller, T.J.E., 1989, Brushless permanent magnet and reluctance motor drives, Clarendon Press, Oxford.

- Kenjo, T., 1989, Stepping motors and their microprocessor control, Clarendon Press, Oxford.

REFERENCES

- Kenjo, T and Naganori, S., 1989, Permanent Magnet and brushless DC motors, Clarendon Press, Oxford.

- Kenjo, T., 1989, Power Electronics for the microprocessor Age.

- Bose, B.K., 1997, Modern Power Electronics & AC drives, Prentice Hall, New Jersey.

Special Paper III: 24REEE314 ADVANCED BIO-MEDICAL DIGITAL SIGNAL PROCESSING

(Effective from the academic year 2024-2025 onwards)

UNIT- I: INTRODUCTION TO WAVELET TRANSFORMS

Basics of FT,FFT, DTFT, OFT, 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

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

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

UNIT- IV: ADAPTIVE FILTERS &ECG DATA REDUCTION TECHNIQUES

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:

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

TEXT BOOKS

- Biomedical Signal Processing: Principles and Techniques, Tata McGraw-Hill Education, 2005 - Biomedical engineering.

- James D. Broesch, Dag Stranneby and William Walker. Digital Signal Processing: Instant access. Butterworth-Heinemann, 2004

REFERENCES

- VLSI digital signal processing systems Keshab K. Parhi, 1999

- Digital signal processing in VLSI Richard J. Higgins Prentice Hall, 1990.

Special Paper III: 24REEE315POWER SECTOR ECONOMICS, MANAGEMENT AND RESTRUCTURING
(Effective from the academic year 2024-2025 onwards)

UNIT-I POWER SECTOR IN INDIA, ECONOMICS AND REGULATION

Introduction to various institutions in Indian Power sector such as CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, state and central governments, REC, utilities and their roles. Critical issues / challenges before the Indian power sector, Salient features of Electricity act 2003, Various national policies and guidelines under this act. Typical cost components and cost structure of the power sector, Different methods of comparing investment options, Concept of life cycle cost, annual rate of return, methods of calculations of Internal Rate of Return(IRR) and Net Present Value(NPV) of project, Short term and long term marginal costs, Different financing options for the power sector . Different stakeholders in the power sector, Role of regulation and evolution of regulatory commission in India, types and methods of economic regulation, regulatory process in India.

UNIT-II POWER TARIFF

Different tariff principles (marginal cost, cost to serve, average cost), Consumer tariff structures and considerations, different consumer categories, telescopic tariff, fixed and variable charges, time of day, interruptible tariff, different tariff based penalties and incentives etc., Subsidy and cross subsidy, life line tariff, Comparison of different tariff structures for different load patterns. Government policies in force from time to time. Effect of renewable energy and captive power generation on tariff. Determination of tariff for renewable energy.

UNIT-III POWER SECTOR RESTRUCTURING AND MARKET REFORM

Different industry structures and ownership and management models for generation, transmission and distribution. Competition in the electricity sector- conditions, barriers, different types, benefits and challenges Latest reforms and amendments. Different market and trading models / arrangements, open access, key market entities- ISO, Genco, Transco, Disco, Retailco, Power market types, Energy market, Ancillary service market, transmission market, Forward and real time markets, market power.

UNIT-IV ELECTRICITY MARKETS PRICING AND NON-PRICE ISSUES

Electricity price basics, Market Clearing price (MCP), Zonal and locational MCPs. Dynamic, spot pricing and real time pricing, Dispatch based pricing, Power flows and prices. Optimal power flow Spot prices for real and reactive power. Unconstrained real spot prices, constrains and real spot prices. Non price issues in electricity restructuring (quality of supply and service, standards of performance by utility, environmental and social considerations) Global experience with electricity reforms in different countries.

UNIT -V TRANSMISSION PLANNING AND PRICING

Transmission planning, Different methods of transmission pricing, Different transmission services, Congestion issues and management, Transmission cost allocation methods, Locational marginal price, firm transmission right. Transmission ownership and control, Transco and ISO, Transmission pricing Model in India, Availability based tariff, role of load dispatch centers (LDCs) Salient features of Electricity act 2003, Price based Unit commitment, concept of arbitrage in Electricity markets, game theory methods in Power System, security constrained unit commitment. Ancillary services for restructuring, Forward ancillary service auction. Power purchase agreements.

TEXT BOOKS

- Sally Hunt, Making Competition Work in Electricity, 2002, John Wiley Inc.

- Electric Utility Planning and Regulation, Edward Kahn, American Council for Energy Efficient Economy. 1988

REFERENCES

- Regulation in infrastructure Services: Progress and the way forward - TERI, 2001.

- Maharashtra Electricity Regulatory Commission Regulations and Orders - Various publications, reports and presentations by Prayas, Energy Group, Pune ,2011

- Central Electricity Regulatory Commission, Regulations and Orders - Electricity Act 2003 and National Policies – Market Operations in Electric Power Systems Forecasting, Scheduling and Risk

Special Paper III: 24REEE316 WIND ENERGY CONVERSION SYSTEMS
(Effective from the academic year 2024-2025 onwards)

UNIT I INTRODUCTION
Wind machine types, classification, parameters. Wind, its structure, statistics, measurements, data presentation, power in the wind.

UNIT II AERODYNAMICS THEORY AND WIND TURBINE TYPES
Wind turbine aerodynamics, momentum theories, basic aerodynamics, airfoils and their characteristics, Horizontal Axis Wind Turbine (HA WT) - Blade Element Theory, wake analysis, Vertical Axis Wind Turbine (VA WT) aerodynamics.

UNIT III HORIZONTAL AXIS WIND TURBINE
HAWT rotor design considerations, number of blades, blade profile, 2/3 blades and teetering, coning, power regulation, yaw system, tower.

UNIT IV MODERN WIND TURBINE CONTROL
Wind turbine loads, aerodynamic loads in steady operation, wind turbulence, static - dynamic - fatigue analysis, yawed operation and tower shadow, WECS control system, requirements and strategies.

UNIT V WIND ENERGY CONVERSION SYSTEM
Wind Energy Conversion System (WECS) siting, rotor selection, Annual Energy Output (AEO). Synchronous and asynchronous generators and loads, integration of wind energy converters to electrical networks, inverters. Testing of WECS- Noise- Miscellaneous topics.

TEXT BOOKS:

- Kaldellis., Stand-alone and hybrid wind energy systems,CRS Press,2010

- John D Sorensen and Jens N Sorensen,Wind energy systems,Woodhead publishi8ng Ltd,2011

REFERENCES

- Mario Garcia Sanz,Wind Energy Systems,CRC Press,2012

- Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, ASME Press, NY 1994.

Special Paper III: 24REEE317 THEORY AND DESIGN OF NEURO-FUZZY CONTROLLERS
(Effective from the academic year 2024-2025 onwards)

UNIT-I NEURAL NETWORK

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules types of neural networks-single layer, multilayer-feed forward, feedback networks; back propagation learning and training-Hop field network.

UNIT-II NEURAL NETWORKS IN CONTROL

Neural network for non-linear systems-schemes of neuro control-system identification forward model and inverse model-indirect learning neural network control applications-case studies.

UNIT-III FUZZY LOGIC

Fuzzy sets-fuzzy operation-fuzzy arithmetic-fuzzy relations-fuzzy relational equations-fuzzy measure-fuzzy functions-approximate reasoning-fuzzy propositions-fuzzy quantifiers-if-then rules.

UNIT-IV FUZZY LOGIC IN CONTROL

Structure of fuzzy logic controller-fuzzification models-data base-rule base-inference engine de-fuzzification module.

UNIT-V NON-LINEAR FUZZY CONTROL

Introduction of Non-linear fuzzy control-PID like FLC-Sliding mode FLC - Sugeno FLC-adaptive fuzzy control-fuzzy control applications-case studies.

TEXT BOOKS

- Farin Wah, S.S., Filev, D., Langari, R., 2000, Fuzzy control synthesis and analysis, John Wiley and Sons.
- Jacek M Zurada, 1999, Introduction to Artificial Neural Systems, Jaico Publishing House.

REFERENCES

- Kosko, B., 1994, Neural Networks And Fuzzy Sstems, Prentice-Hall of India Pvt.Ltd.
- Klir, G.J. and Folger, T.A., 1993, Fuzzy sets, uncertainty and Information, Prentice-Hall of India Private Ltd.
- Zimmerman, H.J., 1994, Fuzzy set theory-and its Applications, Kluwer Academic Publishers.

Special Paper III: 24REEE318 SOFT COMPUTING TECHNIQUES

(Effective from the academic year 2024-2025 onwards)

UNIT I INTRODUCTION

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

UNIT II ARTIFICIAL NEURAL NETWORKS

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller.

UNIT III FUZZY LOGIC SYSTEM:

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT IV GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and and-colony search techniques for solving optimization problems.

UNIT-VAPPLICATIONS

GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab- Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

REFERENCES

- Oscar Castillo, PatriciaMelin, Soft Computing For Hybrid Intelligent Systems,Wiltold Pedrycz,2008
- Madan M. Gupta, Naresh K Sinha, " Soft computing and intelligent systems: Theory and applications,2000.
- 3. J. Jacek. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 199

Special Paper III: 24REEE319 FLEXIBLE AC TRANSMISSION SYSTEMS
(Effective from the academic year 2024-2025 onwards)

UNIT-I INTRODUCTION

FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers.

UNIT-II SERIES COMPENSATION SCHEMES

Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional, ASC, NGH damping schemes, Modelling and control of thyristor controlled series compensators.

UNIT-III UNIFIED POWER FLOW CONTROL

Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller.

UNIT-IV DESIGN OF FACTS CONTROLLERS

Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, and variable structure resistor control.

UNIT-V STATIC VAR COMPENSATION

Basic concepts, Thyristor controlled reactor (TCR), Thyristors switched reactor (TSR), Thyristor switched capacitor (TSC), saturated reactor (SR), Fixed Capacitor (FC).

TEXT BOOKS

- Mohan Mathur. R., Rajiv.K.Varma, Thyristor–Based Facts Controllers for Electrical Transmission Systems , IEEE press and John Wiley & Sons, Inc, New York ,2002.

- Narin G Hingorani, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, Standards publishers, New Delhi ,2001Flexible AC Transmission, IEEE Spectrum, pp 40-45.

REFERENCES

- Narin G Hingorani, High Power Electronics and Flexible AC Transmission Systems, IEEE High Power Engineering Review volume 8: issue 7,2002

- Einar V Larsen, Juan J Sanchez-Gasca, Joe H Chow, May 1995, Concepts for design of FACTS Controllers to damp power swings, IEEE Trans On Power Systems, Vol.10, No.2.

- Gyugyi.L, July 1992, Unified power flow control concept for flexible AC transmission, IEEE Proc-C Vol.139, No.4.

Special Paper III: 24REEE320 HVDC SYSTEMS
(Effective from the academic year 2024-2025 onwards)

UNIT-I INTRODUCTION

Comparison of AC - DC transmission - Description and application of HVDC transmission - DC system components and their functions.

UNIT-II ANALYSIS OF HVDC CONVERTERS

Pulse number - converter configuration, analysis greatz circuit - bridge characteristics - 12-pulse converter.

UNIT-III HVDC SYSTEM CONTROL

Principles of DC link control - converter control characteristics - system control, firing angle control – current and excitation angle control, DC link power control - higher level controllers - reactive power control and VAR sources - Multi terminal DC system - types - control and protection.

UNIT-IV TRANSIENT STABILITY ANALYSIS

Modelling of converter - DC network - AC network and synchronous generator -solution methodology - transient stability improvement using DC link control.

UNIT-V DYNAMIC STABILITY AND POWER MODULATION

Power modulation controls, reactive power modulation, voltage stability in AC -DC systems control.

TEXT BOOKS:

- Naidu, M. S. and Kamaraju, V, High Voltage Engineering, Tata McGraw Hill, New Delhi ,2004
- Padiyar K.R., " HVDC power transmission system ", Wiley Eastern Pvt. Ltd., 1990.

REFERENCES

- Arrillaga J. and Arnald C.P., & Parker B.J., " Computer modeling of Electric power systems ", John wiley& sons, 2001.

- Arrillaga J., " High voltage direct current transmission ", Peter Peregrinus, London, 1983.

Special Paper III: 24REEE321DIGITAL POWER SYSTEM PROTECTION
(Effective from the academic year 2024-2025 onwards)

UNIT- I NUMERICAL PROTECTION

Introduction, block diagram of numerical relay, sampling theorem, correlation with a reference wave, least error squared (LES) technique, digital filtering, numerical over- current protection.

UNIT- II DIGITAL PROTECTION OF TRANSMISSION LINE

Introduction, Protection scheme of transmission line, distance relays, traveling wave relays, digital protection scheme based upon fundamental signal, hardware design, software design, digital protection of EHV/UHV transmission line based upon traveling wave phenomenon, new relaying scheme using amplitude comparison.

UNIT- III DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR

Introduction, faults in synchronous generator, protection schemes for synchronous generator, digital protection of synchronous generator.

UNIT- IV DIGITAL PROTECTION OF POWER TRANSFORMER

Introduction, faults in a transformer, schemes used for transformer protection, digital protection of transformer

UNIT-V DISTANCE AND OVERCURRENT RELAY SETTING AND CO-ORDINATION PC APPLICATIONS IN SHORT CIRCUIT STUDIES FOR DESIGNING RELAYING SCHEME

Directional instantaneous IDMT over current relay, directional multi zone distance realy, distance relay setting, co-ordination of distance relays, co-ordination of over current relays, computer graphics display, man-machine interface subsystem, integrated operation of national power system, application of computer graphics.

Types of faults, assumptions, development of algorithm for S.C. studies, PC based integrated software for S.C. studies, transformation to component quantities, S.C. studies of multiphase systems. Ultra high speed protective relays for high voltage long transmission line.

TEXT BOOKS

- L. P. Singh, Digital Protection, New Age International Private Ltd. Publishers, New Delhi, 2nd Edition,1997
- Paithankar, Marcel and Dekker, Transmission Network Protection, New York,1997

REFERENCE

- Paithankar & Bhide, Fundamentals of Power System Protection, Prentice Hall of India Pvt Ltd., New Delhi,2010
- Stanley Horowitz, Protective Relaying for Power System II IEEE press, New York,1992

Special Paper III:24REEE323 OPTIMIZATION TECHNIQUES
(Effective from the academic year 2024-2025 onwards)

UNIT I INTRODUCTION:
Historical Development, Engineering application of Optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems.

UNIT II LINEAR PROGRAMMING:
Graphical method, Simplex method, Revised simplex method, Duality in linear programming (LP), Sensitivity analysis, other algorithms for solving LP problems, Transportation, assignment
and other applications.

UNIT III NON LINEAR PROGRAMMING:
Unconstrained optimization techniques, Direct search methods, Descent methods, Constrained optimization, Direct and indirect methods, Optimization with calculus, Khun-Tucker conditions.

UNIT IV DYNAMIC PROGRAMMING:
Introduction, Sequential optimization, computational procedure, curse of dimensionality.

UNIT V ADVANCED TECHNIQUES OF OPTIMIZATION:
Introduction, Genetic algorithms for optimization and search.

TEXT BOOKS:

- S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International (P) Ltd., New Delhi, 2000.

- K. Deb, "Optimization for Engineering Design - Algorithms and Examples", Prentice-Hall of lndia Pvt. Ltd., New Delhi, 1995.

REFERENCE:

- H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.

- G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.

Special Paper III 24REEE323EMBEDDED SYSTEMS
(Effective from the academic year 2024-2025 onwards)

UNIT-I INTRODUCTION TO EMBEDDED SYSTEM (09)

An embedded system, functional building block of embedded system, Characteristics of embedded system, applications, Challenges in embedded system design, embedded system design processes.

UNIT-II ARCHITECTURE OF EMBEDDED SYSTEM (09)

Computer architecture taxonomy, CPUs–programming input and output, Supervisor mode, exceptions and traps, Co-processors, memory system mechanisms-CPU bus-memory devices - I/O devices – component interfacing - Assembly and linking-basic compilation techniques.

UNIT-III OSFOR EMBEDDED SYSTEMS (09)

Introduction to RTOS, multiple tasks and multiple processes, context switching, operating system,schedulingpolicies,interprocesscommunicationmechanisms.Introductionto µC/OSII

UNIT-IV PERFORMANCE ISSUSESOFEMBEDDED SYSTEMS (09)

CPU Performance, CPU Power consumption, Analysis and optimization of execution time, program size, energy and power, Evaluating operating system performance, power optimization strategies for processes, Hardware accelerators.

UNIT-V DESIGN ANDIMPLEMENTATION (09)

Development and debugging, manufacturing, Testing, Program validation and testing, Need of Distributed embedded architecture, I^2C Bus, CAN Bus, Design examples: GPS Moving map, Personal Digital Assistant, Elevator controller.

REFERENCES

- Wayne Wolf,, Computers as Components: Principles of Embedded Computer Systems Design, The Morgan Kaufmann Series in Computer Architecture and Design Harcourt Asia Pvt.Ltd., Dehiwella, Srilanka 2000
- Rajkamal, Embedded Systems Tata McGraw-Hill Publishing company Ltd., New Delhi, 2003
- David E, Simon, An Embedded software primer Pearson education India, New Delhi 2004
- Sriram V Iyer, Pankaj Gupta, , Embedded Real-time Systems Programming Tata McGraw-Hill Publishing 2004

WEBSITES

1. www.ece.cmu.edu
2. www.cs.rice.edu

Special Paper III 24REEE324 Artificial Intelligence Applications to Power Systems
(Effective from the academic year 2024-2025 onwards)

UNIT-I INTRODUCTION TO EXPERT SYSTEMS

Basics of AI systems - introduction to expert systems - definitions - architecture - differences from conventional programming.

UNIT-II EXPERT SYSTEMS

Knowledge components-levelsofrepresentation-representationschemes-formaland non-formal representation Schemes-Expert System building task-development- knowledge acquisition-typical building process

UNIT-III INTRODUCTION TO NEURAL NETWORKS

Neuro biological models of neurons-basics of ANN- perceptron- backpropagation network– memory models-bi-directional associative memory -Hopfield network.

UNIT-IV ARTIFICIAL NEURAL NETWORKS

Theory, architecture and applications of computer propagation network- Boltzmann's network– adaptive resonance theory-introduction to cognitron and neo-cognitron.

UNIT-V APPLICATION OFAITO POWER SYSTEMS

Application of expert systems and neural networks in load forecasting, contingency analysis, VAr control and other power system problems.

REFERENCES

- Rolston, D.W Principles of AI and EI development McGraw Hill, New York 1988
- Wassermann P.D, Van Reinhold Neural Computing Springer, New York 1988
- DejanJ. Sobajic IEEE tutorial on application of Neural Network to power systems Lawrence Erlabum associates, Inc., USA 1996.

WEBSITES

1. www.slideshare.net
2. www.globalspec.com