S-VYASA Deemed to be University

School of Advanced Studies

(Under section 3 of the UGC act, 1956)

Sattva Global City, Bengaluru-560059

REGULATIONS (AMENDED) GOVERNING THE DEGREE OF

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

(With effect from January 2025 onwards)

MESSAGE FROM HONORABLE CHANCELLOR

Dr. H R Nagendra

Dr. H R Nagendra
Chancellor
S-VYASA (Deemed to be University),
Bengaluru.

The education system in India has a very long history, which speaks of the system of education existed and its role in building the society. The ancient system of education that prevailed over most part of the nation has laid the foundation to place the country as leader in imparting education. Though the modern education System which prevailed over few centuries back tried to mask the traditional system of education prevailed in India, it may be noticed that gradually most of the countries across globe are adopting the traditional (Gurukula) system of education, on understanding the fact that the traditional system of education molds the Individual to face any challenges in the life.

S-VYASA aims to provide high-quality professional education in Yoga, combining the best of the east and the best of the west. The Ph.D. program provides a unique opportunity for all the scholars to unravel the ancient lore and fathom the new Dimensions using empirical methodologies.

I take opportunity to express my heartfelt thanks and also congratulate Dr. B R Ramakrishna, Vice-Chancellor, Dr. N K Manjumnath, Pro-Vice Chancellor, Prof. M K Sridhar, Registrar, Dr. Sony Kumari, Dean of Academics in taking this task forward.

I wish the Ph.D scholars an enlightening experience which would earmark a journey towards academic excellence.

With Love,

Dr. H R Nagendra

MESSAGE FROM HONORABLE VICE-CHANCELLOR

Vice Chancellor

Dr. Manjunath NK

Vice-Chancellor,

S-VYASA Deemed to be University,

Bengaluru

The Doctor of Philosophy (Ph.D.) is a research-oriented program for those who have the nature of seeking greater depths of knowledge. Swami Vivekananda Yoga Anusandhana Samsthana aims to provide high-quality professional education in Yoga, combining the best of the east (ancient wisdom) and the best of the west (scientific research). The Ph.D. program provides a unique opportunity for all the scholars to unravel the ancient lore and fathom the new dimensions using empirical methodologies. As the world is looking beyond the scope of modern medicine, students pursuing their academia and research in Yoga and integrative medicine shall guide the society towards holistic health and wellbeing,

According to our ancient education system, Guru-Sishya (गुरु-शिष्य) parampara has a significant role in indoctrinating the student and freedom to question. Reviving this legacy in our Ph.D. program, we are making sure that the guide and the student have a chance to strive for the most exhilarating and memorable experience in their research journey. Ph.D. is not a degree for commemoration. It is the first step of "Anvesana," seeking higher dimensions of learning.

The Ph.D. program manual contains a wealth of information that will help doctoral scholars to understand the policies and procedures governing course work, various timelines, monitoring semester-wise progress, the structure of pre-synopsis, thesis and executive synopsis, and guidance for publications in the context of completing research work. This manual will act as a ready reckoner for all doctoral scholars by providing answers to the most frequently asked questions. I wish the scholars a great learning experience.

With best regards,

Dr. Manjunath NK

Ph.D. Regulations 2024

(Regulations for the academic year 2024-25 onwards)

Preamble

To incorporate the guidelines issued by UGC vide Notification dated 5th May 2016, No.F.1-2/2009(EC/PS)V(I) Vol(II), the following amendments have been made in the regulation for Ph.D. Course of School of Advanced Studies, S-VYASA (Deemed to be University). Hence this amended regulation for the Ph.D. Course.

CONTENTS

1. Short title, Application and Commencement.

These regulations shall be called 'Ph.D. Regulations 2024. These regulations shall come into force from August 2024 with acceptance of the Board of Management.

2. Definitions

In these Regulations unless the context requires otherwise or it is specifically so defined:

a. GOI means 'Government of India' in abbreviated form.
b. GOK means 'Government of Karnataka' in abbreviated form.
c. UGC means 'University Grants Commission' established at New Delhi by an Act of Parliament in 1956.
d. S-VYASA (Deemed to be University) means 'Swami Vivekananda Yoga Anusandhana Samsthana', with its headquarters at Bangalore, Karnataka.
e. S-VYASA-RET mean S-VYASA Research Entrance Test conducted by the University for preparing the merit list of candidates for admission to the Ph.D. course.
f. Admission Committee means'a committee constituted by the University to carry out the activities concerning the admission of candidates to the Ph.D. Course'.
g. Course work means 'the programs prescribed as a part of the Ph.D. Course, which all the candidates shall successfully complete as a pre-requisite'.
h. Research work means 'the research work/project carried out by the candidate during his Ph.D course.
i. Research Supervisor means 'a qualified faculty member / scientist recognized by the University to supervise/ guide the Ph.D. candidates'.
j. Co-Research Supervisor means 'the additional Research Supervisor who supervises/guides the doctoral research of a candidate along with the Research Supervisor'.
k. Research Advisory Committee (RAC) means 'the Committee constituted by the University to review the research progress of a research scholar'.
l. Viva Voce Board means 'a Committee of experts appointed by the University to conduct the final viva-voce on

the Thesis submitted by the candidate'.

3. Duration of the Ph.D. Course:

3.1 Ph.D. Course, Full Time shall be for a minimum duration of three years including course work and a maximum of six years. Part- Time shall be for a minimum duration of Four years including course work and a maximum of seven years.

3.2 Under special circumstances, provision for extension beyond the above limits, subject to a maximum of one year, shall be granted on the recommendation of the High-Power Committee and approved by the Vice Chancellor.

3.3 The women candidates and Persons with Disability (more than 40% disability) may be allowed a relaxation of two years for Ph.D. in the maximum duration, including Maternity Leave/Child Care Leave once in the entire duration of Ph.D. course.

4. List of Divisions:

The University shall permit the registration for Ph.D. under Allied Sciences category in the following Divisions, namely,

1. PhD in Computer Science.

A candidate is allowed to pursue Ph.D. program in a subject area of inter-disciplinary nature subject to the approval from Research Advisory Committee (RAC).

5. Eligibility criteria for admission to Ph.D. Course.

The eligibility requirement for candidates to get admitted to the Ph.D. Course shall include the following:

5.1 General eligibility requirements for Part-time/Full-time Ph.D. Course.

The general eligibility requirement for candidates to get admitted to the Ph.D. Course shall include the following:

- ☞ Master degree in Computer Science from a recognized University with 55% aggregate marks.

Full-Time Ph.D. Course

- ☞ The minimum qualification is as per 5.1.
- ☞ During course-work, classes will be conducted on all the working days of S-VYASA Deemed to be university, at Bangalore. Minimum attendance of 90% is to be followed in every subject.

5.1.1 Part-Time Ph.D. Course

- ☞ The minimum qualification is as per 5.1.
- ☞ During course-work, Classes will be conducted on Saturdays and Sundays at S-VYASA. Minimum attendance of 90% is to be followed in every subject.
- ☞ Part time Ph.D. will be allowed provided all the conditions mentioned in the extant Ph.D. Regulations are met.
- ☞ All the part time Ph.D. candidates have to produce No Objection Certificate (NOC) from their parent organization before getting admitted to the course.

5.2 Relaxation of Marks for special categories.

A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently - Abled and other categories of candidates as per the decision of the Commission from time to time, or for those who had obtained their Master's degree prior to 19th September, 1991. The eligibility marks of 55% (or an equivalent grade in a point scale wherever grading system is followed) and the relaxation of 5% to the categories mentioned above are permissible based only on the qualifying marks without including the grace mark procedures.

6. Admission Procedure

6.1 Entrance Test

- Selection of candidates for Ph.D. Course will be based on qualifying in the national level entrance test Conducted by S-VYASA (Deemed to be University).
- A candidate shall be declared to have passed the entrance test when he/ she scores at least 50% of the marks in the entrance test.

6.2 Interview

- Candidates who have passed the entrance test shall appear for an interview conducted by the Admission Committee where the candidate will be assessed for depth of knowledge, research potential and personality.
- The Research Supervisors having vacancy of research students under them will select the candidates depending on their field of research work.
- The selected student list will be announced along with the guide names after the interview by the Admissions Committee and Division wise selected list will be announced and communicated to the candidates.
- Those who have passed JRF/NET (National Eligibility Test)/SLET/KSET/GATE are exempted from the entrance test, but have to appear for interview with a brief synopsis of their intended research topic.
- The validity of the pass in entrance examination for Ph.D. course is valid for one academic year only, after which the candidate has to undergo the process of admission again.

7. Recognition and Allocation of Research Supervisor

1. Any regular Professor of S-VYASA, Deemed to be University with a Ph.D. degree and at least five research publications in refereed journals and any regular Associate/Assistant Professor of S-VYASA, Deemed to be University with a Ph.D. degree and at least two research publications in refereed journals after his/her Ph.D. may be recognized as Research Supervisor.
2. Provided that in areas/disciplines where there is no or only a limited number of refereed journals, the Research Advisory Committee of the University may relax the above condition for recognition of a person as Research Supervisor with reasons recorded in writing.
3. Co-Research Supervisor can be allowed in inter-disciplinary areas from other Divisions of the University or from other related institutions with the approval of the Research Advisory Committee. Co-Research Supervisors should have a Ph.D. with minimum 2-post doctoral publications and 2-years of experience.
4. The reallocation of Research Supervisor for a selected research scholar, in case the allotted Research Supervisor leaves the university or any other emergencies shall be decided by the division concerned depending on the number of vacancy of scholars per Research Supervisor, the available specialization among the Research Supervisors and research interests of the scholars as indicated by them at the time of interview.
5. In case of topics which are of inter-disciplinary nature where the Division concerned feels that the expertise in

the Division/Department has to be supplemented from outside, the Division may appoint a Research Supervisor from the Division itself, who shall be known as the Research Supervisor, and a Co-Supervisor from outside the Division/ University on such terms and conditions as may be specified and agreed upon by the consenting Institutions/Colleges.

6. A Research Supervisor/Co-supervisor who is a Professor, at any given point of time, cannot guide more than Eight (8) Ph.D. scholars. An Associate Professor as Research Supervisor can guide up to a maximum of Six (6) Ph.D. scholars and an Assistant Professor as Research Supervisor can guide up to a maximum of four (4) Ph.D. scholars, including reservation category.
7. A candidate cannot change his/her Research Supervisor /Co-Research Supervisor during his/her complete Ph.D. course except in case of emergency, approved by RAC.

8. Ph.D. Research Course details

Ph.D. Course consists of the following Steps:

1. Course work.
2. Presenting 4 closely relevant base papers before the Research Committee
3. Getting approval of Comprehensive Project Evaluation Board.
4. Submission and presentation of Pre-Synopsis to the RAC.
5. Getting the clearance from relevant regulatory bodies and committees for the Experimental work if applicable.
6. Starting of Experimental work.
7. Semester progress reports presentation (every 6 months) in front of RAC.
8. Presenting minimum 2-research papers in International Conferences.
9. Writing of Research papers and submits to the journals.
10. Publication / Acceptance of
    - Minimum 3-research papers in UGC-CARE approved list of journals or standard indexing databases like Web of Science, SCI, Scopus.
    - Presentation and submission of Executive Synopsis.

Plagiarism Check. (The Research Supervisor should submit the soft copy of the thesis to plagiarismcheck@svyasa.

edu.in). The results of plagiarism check should satisfy the UGC norms as mentioned in the UGC website.

Thesis submission and adjudication by Reviewers (National and International) with favorable report by all reviewers.

Formation of Viva-Voce Committee.

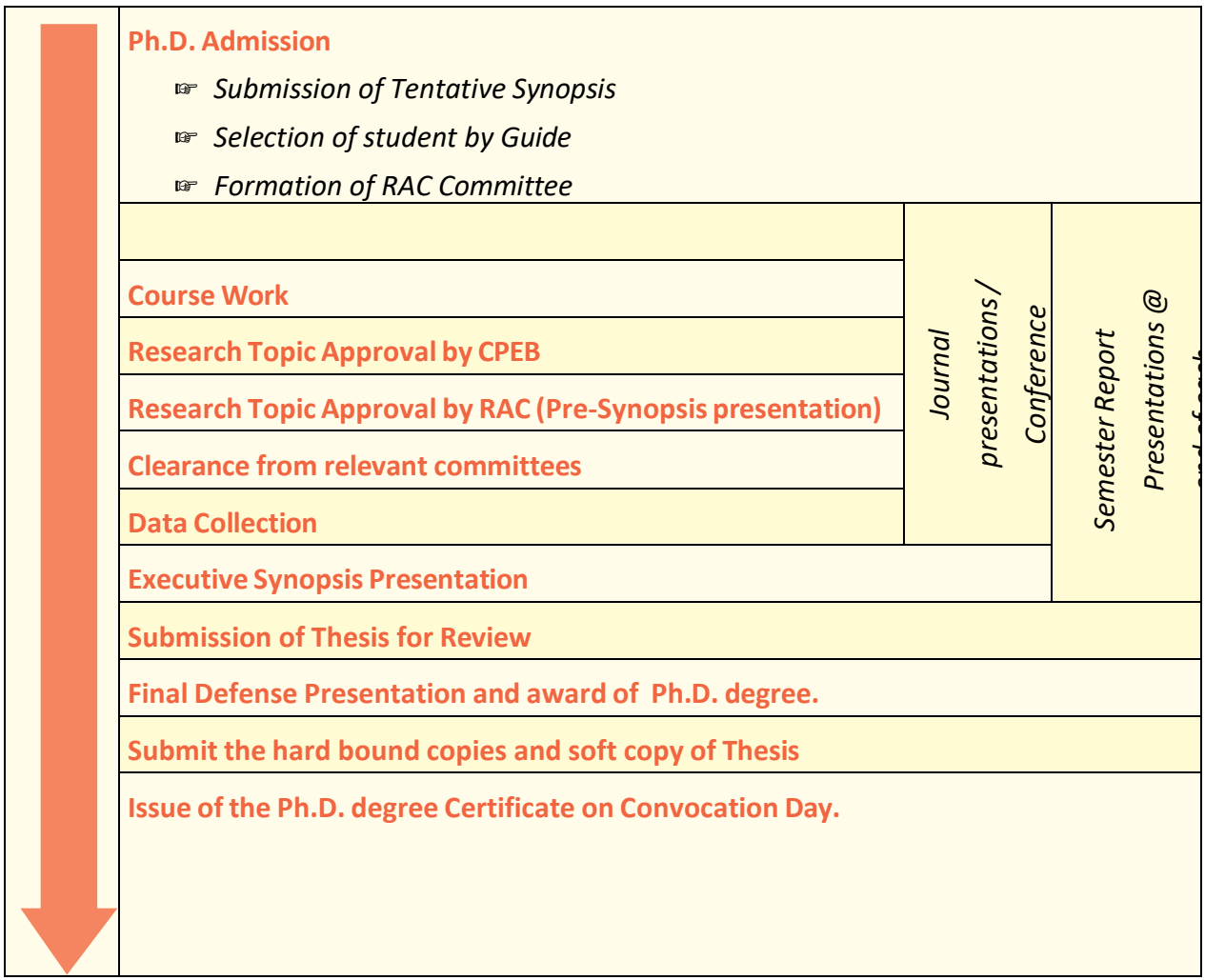
Final defense of the thesis by the candidate (Final Viva-Voce) and award of degree.

Submission of copies of Four hard bound and Electronic copies of the thesis incorporating all the corrections recommended by the Committee.

Provisional Certificate to be issued after submission of all the necessary documents.

Issue of the Ph.D. Degree Certificate on Convocation day (January 12th of each year).

Note: The above points are mostly relevant for students undertaking empirical studies, however for those students undertaking theoretical studies the process may slightly vary, which will be discussed on case-by-case basis.


Ph.D. Admission
Submission of Tentative Synopsis
Selection of student by Guide
Formation of RAC Committee
Course Work
Research Topic Approval by CPEB
Research Topic Approval by RAC (Pre-Synopsis presentation)
Clearance from relevant committees
Data Collection
Executive Synopsis Presentation
Journal presentations / Conference
Semester Report Presentations @
Submission of Thesis for Review
Final Defense Presentation and award of Ph.D. degree.
Submit the hard bound copies and soft copy of Thesis
Issue of the Ph.D. degree Certificate on Convocation Day.

Ph.D. Process

8.1 Course-Work:

1. The coursework shall be treated as prerequisite for preparing the Scholars for Ph.D. Degree.
2. The students are suggested to complete the Ph.D. coursework within 1-year from the date of registration for full time students. For part-time students, the maximum duration shall be 1.5 years.
3. The Ph.D. Course work shall comprise of one mandatory subject as prescribed by UGC, on "Research Methodology", one on the subject "Introduction to Yoga Philosophy" and other two subjects can be chosen based on the student's area of specialisation duly approved by the Research Advisory Committee.
4. The Division where the scholar pursues his/her research shall prescribe the subject(s) to him/her based on the recommendations of the Research Advisory Committee.
5. Grades in the course work, including Research Methodology and Introduction to Yoga Philosophy subjects shall be finalized after a combined assessment by the Research Advisory Committee and the Division and the final grades shall be communicated to the candidate.
6. A Ph.D. scholar has to obtain a minimum of 50% of marks Course work in order to be eligible to continue Ph.D. course and submit the dissertation/thesis. Note that every subject should be passed within two attempts, otherwise his/her admission to Ph.D. course stands cancelled.
7. Candidates failing to fulfil the above requirements are liable to get their registration automatically cancelled and no further extension will be permissible for completing the course work. Such candidates are free to apply for re-admission into Ph.D.

8.2 Semester Progress Reports:

1. A research scholar shall appear before the Research Advisory Committee once in six months (every semester) to make a presentation of the progress of his/her work for evaluation and further guidance. The semester progress reports shall be submitted by the Research Advisory Committee to the Ph.D. Department with a copy to the research supervisor.
2. In case the progress of the research scholar is unsatisfactory, the Research Advisory Committee shall record the reasons for the same and suggest corrective measures. If the research scholar fails to implement these corrective

measures, the Research Advisory Committee may recommend to the University, with specific reasons, for cancellation of the registration of the research scholar.

3. If the Ph.D. research scholar fails to submit the two consecutive progress reports or abstains from presentation of progress report, the RAC may recommend for cancellation of the registration of the research scholar.
4. If the research scholar fails to complete the entire Ph.D. work including the submission of thesis within the stipulated period, the registration of the research scholar shall be cancelled as per the university regulations.

8.3 Journal presentations:

1. It is mandatory to present 4 published research papers related to their topic of research in the Journal for the completion of the Ph.D. course. Students are suggested to present at least two research papers before their Pre-synopsis presentation befor the research committee.
2. The presentation will be conducted division wise, under the presence of Research Supervisors, Deans and other Ph.D. scholars and faculties. The presentation schedule will be communicated by the Division In charge for JC presentation, at the beginning of each semester.
3. Scholars should select only the published papers from high impact factor journals or the best journal related to their area of research.
4. Research scholars who are involved in theoretical research can present critical review of Books /Articles related to their topic of research.
5. The selected papers / books should be approved by the Research Supervisor before presentation.

8.4 Pre-Synopsis Presentation:

1. Ph.D. scholar should complete his/her Course-work and is also suggested to complete 2-JC presentations before Pre-Synopsis presentation.

   The Research Supervisor shall submit the Pre-synopsis document of Student's Research Proposal to the Comprehensive Project Evaluation Board (CPEB) for approval through e-mail: cpeb@svyasa.edu.in

   - ☞ Research Proposals submitted until 10th of every month will be evaluated by Sub-committees.
   - ☞ The Final report of CPEB along with recommendations on technical and ethical aspects will be shared with the member secretary of IEC and the respective Research Supervisors.
   - ☞ The Research proposal, incorporating the changes as recommended, shall be approved by CPEB.

2. After CPEB approval, research supervisor shall request Ph.D. office in the prescribed format for Pre-Synopsis presentation in the presence of Research Advisory Committee, by submitting the below documents
   a. CPEB approval.
   b. One hard copy of Pre-Synopsis with spiral binding (duly signed by Research Supervisor)
   c. Soft-copy of the Pre-Synopsis document.
   d. Soft-copy of the Power Point Presentation of Pre-Synopsis.
   e. Soft-copy of the CV with a color photo of the External Expert.
   f. Ph.D. office will take minimum 15 working days for further processing.
3. The duration of presentation will be 20 minutes, followed by 10-minutes Questions/Answers and discussion. First interaction is by the external expert and then by others.
4. Any suggestions / remarks by the Research Advisory Committee have to be incorporated into the Pre-Synopsis document. The revised soft-copy of the Pre-Synopsis document should be submitted by the Research Supervisor to the Ph.D. office, after getting the approval of the external expert. Ph.D. office will then provide the RAC clearance certificate. Then, Ph.D. scholars shall proceed for IEC approval.

8.5 Approval from respective committees and Data Collection:

1. Following the approval of Pre-Synopsis, the candidate shall present the required design and plan of action to Research committee (RC), City Campus for approval.
2. The Research committee meeting will be tentatively conducted once in 3 months.
3. Candidate must follow the template provided by the Research Committee.
4. The presentation date will be fixed by the Research Committee and the same will be conveyed to the students.
5. Further, comments will have to be provided by the students for the clarifications sought by the RC (if any) during presentation.
6. Further to approval of the clarifications provided by the student to the RC, clearance certificate will be issued to the student.

8.2 Presentation in Conferences / Seminars:

Every Ph.D. scholar should make minimum **two research paper presentations** in International conferences, and produce the evidence for the same in the form of presentation certificates and/or reprints.

8.3 Paper-Publications:

Every Ph.D. scholar should publish research papers in the refereed journals and produce evidence for the same. It's necessary to publish / acceptance of -

- Minimum 3-research papers in UGC-CARE approved list of journals or standard indexing databases like Web of Science, SCI, Scopus.

8.4 Executive-Synopsis Presentation:

A Ph.D. scholar should fulfill the below requirements before the Executive Synopsis Presentation:

a. Presentations before Research Committee

b. Conference/ seminar presentations

c. Publication / Acceptance of Research papers

The research Scholar shall inform Ph.D. office for Executive-Synopsis presentation in the presence of Research Advisory Committee, by submitting the below documents as per the format.

1. One hard copy of Executive-Synopsis with spiral binding (duly signed by the Research Supervisor) in the prescribed format.
2. Soft-copy of the Executive-Synopsis document.
3. Soft-copy of the Power Point Presentation of Executive-Synopsis.

The duration of presentation will be 30 minutes, followed by 20-minutes Questions/Answers and discussion by the external examiner. 10 minutes Questions/Answers by others.

The same External Examiner who evaluated the pre-synopsis shall evaluate the Executive Synopsis. In case of long absence or retirement of the External Examiner, or for any other valid reasons, the Supervisor can request the Dean of Academics for a replacement.

Any suggestions / remarks by the Research Advisory Committee have to be incorporated into the Executive-Synopsis document. The revised soft-copy of the Executive-Synopsis document should be submitted by the Research Supervisor to the Ph.D. office. Then, Ph.D. scholars shall proceed for submission of Thesis.

After Executive-Synopsis presentation,

- ☞ RAC makes a panel of national and international reviewers (minimum 3 and maximum 5) for thesis review.
- ☞ Research supervisors shall submit the reviewers list along with their biodata to Ph.D. office.
- ☞ Eligibility criteria for National and International reviewers: with Ph.D. degree/MD and at least five research publications in refereed journals and any regular Associate/Assistant Professor in any recognised University.

8.5 Thesis Submission and Evaluation by the External reviewers:

1. Following the approval of Executive-Synopsis, Ph.D. scholar should submit the following documents to Ph.D. office.
   - ☞ Thesis in the prescribed format (two spiral binding copies)
   - ☞ Thesis submission Proforma
   - ☞ List of National and International Reviewers along with their biodata
   - ☞ Plagiarism clearance certificate
2. Ph.D. Department will forward the same to the Examination Department for further processing.
3. Two external reviewers, One national & One international from the panel suggested by RAC, are selected by the Vice - Chancellor for the thesis evaluation.
4. It takes a minimum period of 30 working days to maximum period of 90 working days for the evaluation of thesis. After this period, the reviewers are asked to submit their comments and an evaluative report of the thesis to Controller of Examinations and this in turn is communicated to the candidate and the supervisors.
5. The candidate is asked to write the responses of each comment and the same needs to be executed in the thesis. All the responses written by the candidate is communicated to the reviewers.

Guidelines for Plagiarism Check:

Research supervisor should send the electronic-copy of the thesis (MS-Word Document) for Plagiarism checking to plagiarismcheck@svyasa.edu.in. and get a report.

The plagiarism check results should satisfy the 10% limits suggested by the UGC.

8.6 Open Defense (viva-voce) and award of Ph.D. degree:

1. The public viva-voce of the Ph.D.-scholar to defend the thesis shall be conducted only if the evaluation reports of the external examiners (both National and International) on the thesis are satisfactory and include a specific recommendation for conducting the viva-voce examination.
2. If one of the evaluation reports of the external examiner, is unsatisfactory and does not recommend viva-voce, the Institution shall send the dissertation/ thesis to another external examiner out of the RAC approved panel of examiners and the viva-voce examination shall be held only if the report of the latest examiner is satisfactory. If the report of the latest examiner is also unsatisfactory, the thesis shall be rejected and the research scholar shall be declared ineligible for the award of the degree.
3. Following the approval by the External reviewers, the Examination Department notifies an open defense for the candidate by inviting one of the reviewers and the Viva-Voce Committee and it becomes open for all the researchers and teaching staff of the University.
4. Following the Open Defense and two favorable opinions by the Experts (both Internal and external) the candidate is called and communicated regarding his/her viva-voce results. On the recommendation of the doctoral committee, the award of the Ph.D. degree will be announced by VC/Pro-VC /Registrar /Registrar(Evaluation) at the end of final Viva-Voce.

After the successful Open Defense,

1. The Ph.D. scholar has to submit the following to the Ph.D. Office/Examination section.
   a. Three Hard-bound copies with both-sides printing and
   b. The Digital Form of his/her thesis, that includes :
      i. PPT of the final presentation.
      ii. Final thesis in the PDF format.
      iii. All the published papers.
2. Both the Hardbound copy and Digital media will be forwarded by the Ph.D. office to the Library.
3. Electronic copy of the Ph.D. thesis will be uploaded by the Library In charge to the INFLIBNET/Shodganga, for hosting the same so as to make it accessible to all Institutions/Colleges.
4. Convocation requisitions should also be submitted to the Ph.D. office:

a. Convocation Application form (filled in).
b. PPT which contains the brief Bio data of the candidate (Photo- background should be plain, preferably white).
c. Publication details.
d. Abstract of the Thesis.

8.7 Provisional Degree & Convocation:

- After the successful completion of Open Defense, a formal notification will be issued, approved by the Vice – Chancellor and a provisional certificate will be issued to the candidate on application for the same.
- The Ph.D. Degree Certificate is issued to the candidate on the day of the Convocation, January 12th, which is supposed to be the S-VYASA Convocation Day of every year.

9 Boards and Committees

The University shall constitute the following Boards and Committees for monitoring the Ph.D. Programme:

1. High Power Committee
2. Admission Committee
3. Equivalence Committee
4. Comprehensive Project Evaluation Board (CPEB)
5. Research Advisory Committee (RAC)
6. Institutional Ethical Committee (IEC)
7. Viva Voce Board and
8. Such other Boards/Committees, as may be required.

The composition, duties and responsibilities of the Boards and Committees are as given below:

9.1 High - Power Committee

The High-Power Committee shall be constituted by the Vice-Chancellor.

1. Vice Chancellor: Chairperson

2. Director, Academics: Convener
3. Director, Research and Development
4. Dean, Engineering and Technology
5. HOD, Commerce and Management
6. Dean, Allied Sciences
7. External Expert I- Member
8. External Expert I- Member
9. Registrar- Member Secretary

The scope of the Committee shall be,

a. To lay down the policy concerning Ph.D. regulations from time to time.
b. To resolve any issues raised by the Admission Committee or issues referred by the Registrar, S-VYASA, Bangalore.
c. Any other related matter.
d. The tenure of the External Member shall be 3 years. The Committee may meet as often as required, subject to a minimum of two meetings in an academic year.

9.2 Admission Committee

The Admission Committee to be constituted by the Vice Chancellor shall consist of:

1. Dean, Academics - Chairperson
2. One Dean from any Division on rotation to be nominated by VC
3. Nominee of the Academic Council – Member
4. External Expert- 1
5. Officer in-charge of Admissions

6. Registrar - Member Secretary

The Admission Committee shall be responsible for:

a. Identifying the number of seats available for Ph.D. program and notifying in University Web site.
b. Scrutinizing applications for eligibility for Ph.D. Program.
c. To scrutinize the eligibility and appoint Research Supervisor/ Co-Supervisor.
d. Selection of Ph.D. Candidates.
e. Approving the number of candidates under each Research Supervisor division wise.
f. The tenure of the Committee shall be 2 years. The Committee shall meet as often as required.

9.3 Equivalence Committee

The Equivalence Committee to be constituted by the Vice Chancellor shall consist of:

1. Dean, Academics - Chairperson
2. One Dean from any Division on rotation to be nominated by VC
3. Deputy Director, Curriculum – Member
4. External Expert- 1
5. Subject Experts
6. Registrar - Member Secretary

The Equivalence Committee shall be responsible:

a. To verify and compare the syllabus of the other Universities from where students have completed their master degree in Engineering, Commerce, management and applied for the course waiver.
b. To scrutinizing applications of the candidates to provide the course waiver.

9.4 Research Advisory Committee (RAC)

The Registrar shall constitute a Research Advisory Committee for each candidate immediately after the provisional registration and shall have the following composition:

1.	Director, Academics	Chairman
2.	Dean/HOD of the Division	Member

3.	Research Co-ordinator, City Campus	Member
4.	Co Supervisor (if any)	Member
5.	Research Supervisor	Convener

All members of the Research Advisory Committee must be recognized research Supervisors. The Committee will be formed from the panel of names suggested by the Supervisor and nominated and approved by the Dean.

This Committee shall have the following responsibilities:

a. (i) To review the research proposal and finalize the topic of research. (ii) To guide the Research Scholar to develop 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 Research Scholar.

b. The first meeting of the Committee shall be within six months after the provisional registration, and in this meeting, the Committee shall prescribe the subject (RAC subject) that the candidate needs to take as requirement for the completion of the course work.

c. A Research Scholar shall appear before the Research Advisory Committee at least once in every semester to make a presentation of the progress of his/her work for evaluation and further guidance.

d. In case the progress of the research scholar is unsatisfactory, the Research Advisory Committee shall record the reasons for the same and suggest corrective measures. If the research scholar fails to implement these corrective measures, the Research Advisory Committee may recommend to the Institution/College with specific reasons for cancellation of the registration of the research scholar.

e. The Committee, after examining the progress made by the Candidate, shall recommend the submission of the Synopsis to the Ph.D. department and suggest one external examiner who is not in the employment of the Institution to approve the pre-synopsis. The pre-synopsis presentation shall be made by the Ph.D. scholar and evaluated by the external Expert in presence of the RAC. The candidate shall endorse changes in the research, if any proposed by the external examiner. The external expert shall become a part of the RAC from the pre-synopsis presentation and continue till the end of research work.

f. The Committee shall approve the names of the Panel of Reviewers, suggested by the Supervisor for the evaluation of the Thesis, and this Panel will be forwarded by the Dean of the Academics to the Controller of Examinations. The Committee shall ensure that all the Reviewers are of high standing in the field of the research

of the Candidate.

NOTE: The External Expert or Reviewer should have a Ph.D. with minimum 2-post doctoral publications and expertization in the field of the research of the Candidate.

9.5 Comprehensive Project Evaluation Board (CPEB)

Comprehensive Project Evaluation Board (CPEB) is formed to evaluate the technical and ethical aspects of the projects and control the redundancy in the research and also to encourage Ph.D. scholars, to design and come up with quality projects.

The key areas of assessment by CPEB is on:

i) Need and Rationale of the study
ii) Design of the study (Technical aspects)
iii) Ethical issues
iv) Financial aspects

All research projects/proposals from all the courses must to be submitted to CPEB through proper channel.

9.6 Institutional Ethics Committee (IEC)

Institutional Ethics Committee (IEC) is the Committee formed of a group of people who examine the research protocol / proposal and state whether or not it is ethically acceptable.

The Vice Chancellor will constitute IEC and it is independent, competent and multi-disciplinary unit.

Constitution of Institutional Ethics Committee:

Sl. No.	Members of EC	Definition/description
1.	**Chairperson/ Vice Chairperson (optional)** Non-affiliated Qualifications - A well-respected person from	• Conduct EC meetings and be accountable for independent and efficient functioning of the committee • Ensure active participation of all members

	any background with prior experience of having served/ serving in an EC	(particularly non-affiliated, non-medical/ non-technical) in all discussions and deliberations • Ratify minutes of the previous meetings • In case of anticipated absence of both Chairperson and Vice Chairperson at a planned meeting, the Chairperson should nominate a committee member as Acting Chairperson or the members present may elect an Acting Chairperson on the day of the meeting. The Acting Chairperson should be a non-affiliated person and will have all the powers of the Chairperson for that meeting. • Seek COI declaration from members and ensure quorum and fair decision making. • Handle complaints against researchers, EC members, conflict of interest issues and requests for use of EC data, etc.

2.	**Member Secretary/ Alternate Member Secretary (optional)** Affiliated Qualifications - • Should be a staff member of the institution • Should have knowledge and experience in clinical research and ethics, be motivated and have good communication skills • Should be able to devote adequate time to this activity which should be protected by the institution	• Organize an effective and efficient procedure for receiving, preparing, circulating and maintaining each proposal for review • Schedule EC meetings, prepare the agenda and minutes • Organize EC documentation, communication and archiving • Ensure training of EC secretariat and EC members • Ensure SOPs are updated as and when required • Ensure adherence of EC functioning to the SOPs • Prepare for and respond to audits and inspections • Ensure completeness of documentation at the time of receipt and timely inclusion in agenda for EC review. • Assess the need for expedited review/ exemption from review or full review. • Assess the need to obtain prior scientific review, invite independent consultant, patient or community representatives. • Ensure quorum during the meeting and record discussions and decisions.

The IEC's Member-secretary screens the research proposals for their completeness and depending on the risk involved, categorize them into 3 types:

1) Exemption from review for proposals that involve less than minimal risk.
2) Expedite review for more than minimal risk proposals, minor protocol amendments, research on disaster management.
3) Full review for more than minimal risk and that involve vulnerable subjects.

The ethical review should be done in formal meetings by all primary reviewers and decision is made only when quorum is complete.

The Committee should meet at regular intervals (Once in three months) and should not keep a decision pending for more than 6 months. Periodic reviews are done as per the SOPs (Standard Operating Procedure).

All the decisions are communicated in writing to the Principal Investigator (PI). Members should be encouraged to attend trainings so that they are aware of all new guidelines and developments.

Elements of review are:

- Design, conduct of the study and approval of review Committees.
- Examination of predictable risks and potential benefits.
- Procedure for selection of subjects including inclusion/exclusion, withdrawal criteria and other issues like advertisement details.
- Management of research related injuries, adverse events and compensation.
- Justification for placebo and availability of products after the study.
- Patient information sheet and informed consent form in English as well as in local language.
- Protection of privacy and confidentiality.
- Plans for data analysis and reporting.
- Adherence to all regulatory requirements and applicable guidelines.
- Competence of investigators, research and supporting staff and facilities.

All documentation & communication of an IEC are dated, filed and preserved up to minimum of three years after completion/termination of the study and strict confidentiality should be maintained during access and retrieval procedures.

COURSEWORK – CREDITS AND EVALUATION FOR PH.D. – COMPUTER SCIENCE

Examination and Evaluation Procedure

1. Letter Grading System

As per the UGC guidelines, University follows l0 point letter grading system

CONVERSION OF MARKS INTO GRADE AND GRADE POINT				CLASSIFICATION (SGPA/YGPA/CGPA GRADING)	
MARKS OBTAINED	GRADE	GRADE POINT	DESCRIPTION	GPA	CLASS
<50%Marks	F	0	Dropped	Less than 5.00	Fail
50 to 55% Marks	C	5	Average	5.00 to 5.50	Pass
55.1 to 60% Marks	B	6	Above Average	5.51 to 6.00	Second Class
60.1 to 70% Marks	B+	7	Good	6.01 to 7.00	First Class
70.1 to 80% Marks	A	8	Very Good	7.01 to 8.00	First Class
80.1 to 90% Marks	A+	9	Excellent	8.01 to 9.00	First Class with Distinction
90.1 to 100% Marks	O	10	Outstanding	9.01 to 10.00	First Class with Distinction

$$\text{SGPA/YGPA/CGPA} = \sum \frac{\text{(No. of credits * Grade Point)}}{\text{No. of Credits}}$$

SGPA/YGPA/CGPA is rounded off to the decimal Place.

2. Assessment Procedure

Assessments include both continuous (internal) and summative (final exam). Student has to secure passing marks both in internal and final exam.

Assessment	Internal	Final Exam
Weightage	50 %	50 %
Marks	Test (30 Mark)+Assignment (15 Mark)+ Faculty Assessment (5 mark) = 50	100

3. Examination schedule

a. Examination dates are scheduled in consultation with Registrar and Dean of Academics.
b. Announcement of examination dates are scheduled forty days prior to the event.
c. Dates scheduled are to match with the dates mentioned in the academic calendar. Under unavoidable circumstances, dates for examination may be rescheduled.
d. The notification of examination schedule shall also include the tentative dates of theory examinations, which shall be followed by issue of notification of detailed time table for practical examinations.
e. All the above-mentioned contents of the notification shall be prominently displayed for information of the candidates.
f. In case there is an obligatory holiday declared during the examination days, the examination scheduled on the holiday will be conducted at the end of all the examinations and the date will be announced accordingly.

4. Internal assessment

As per the academic calendar student has to appear for internal tests and successfully complete assignments.

5. Attendance

a. To qualify for an examination, 90% of attendance is essential. However up to 80% is the minimum with condonation on medical grounds. The medical certificate is to be produced by the student and the medical officer should be approved by the University.

b. Under no circumstances, if the attendance is less than 75%, the candidate will not be eligible for the examination

6. Examination application form

Schedule for issue of exam application forms from the University examination department and schedule for submission of application forms will be notified on University website and notice board.

Cumulative Grade Point Average

Based on the grades obtained in all the subjects registered for by a student, his or her cumulative Grade point Average, Semester Grade Point Average (SGPA), Yearly Grade Point Average (YGPA), and Cumulative Grade Point Average (CGPA) is calculated as follows:

a. Examination forms duly filled, and affixed with latest stamp sized attested photographs of the candidate should be submitted to course office and course office will verify and forward this to the examination department.
b. Candidates filling up their application late, an amount of fine is collected which is also notified.

7. Hall tickets

a. Schedule for issue of hall tickets shall be notified by the University.
b. During exams, candidates are supposed to get the signature from invigilator/external examiner on the space left blank on the column given for the corresponding subject.
c. Hall ticket and ID cards are mandatory for a candidate to carry for entry into examination hall

8. Malpractice

a. Candidates are prohibited from writing their names and register number, in any place other than indicated.
b. Invocation to Gods or any other marks of identification shall not be written anywhere in the answer book.
c. Candidates shall not bring any book, portion of book, manuscript or paper of any description.
d. They shall not copy or communicate with anyone inside or outside the hall or exchange of answer books.
e. Candidates shall not be in possession of cell phones, programmed calculators, pen scanners, blue tooth

equipment or any other equipment which may be used for any kind of malpractice.

f. Every candidate will be subjected to scrutinizing and scanning before entering the examination hall to see that no piece of paper or unwanted material is taken inside.

g. If candidates are found to be indulging in malpractice the candidate shall be booked for malpractice and sent out of the examination hall immediately.

h. The answer book shall be seized, marked as 'malpractice case' and signed by the Chief Superintendent and packed and sent separately to the University.

9. Paper evaluation

Theory paper evaluation will be conducted as per the University guidelines. Answer scripts will be coded and each paper will undergo single evaluation (internal faculty) for all courses under Applied Sciences stream.

10. Examination Results

Examination results will be announced within 30 days from the last day of examination. It will be announced on University website.

11. Re-totalling, Re-evaluation and request for Photocopy of the answer script

University will notify the dates, procedure and fees for Re-totaling, Re-evaluation and request for Photocopy of the answer script.

12. Semester Grade Card

On the opening of the semester, within two weeks, Semester grade card will be issued.

13. Consolidated Grade Card

Consolidated grade card will be issued at the end of the Course, after the convocation.

14. Convocation

The final certificate will be issued during the convocation on 12th January of every year.

General Rules and Regulations of the campus

- Attendance for all the events of the University is compulsory for the student.

- Students must wear Identity Card all the times while they are in class or in the campus. Students will not be allowed to enter the class room/dining hall without his/her identity card. In case of damage or loss of the Identity Card, the student must approach the authorized person immediately.
- Indecent clothing is strictly prohibited in the campus. After the class hours, the students should wear decent dresses like Indian traditional attire i.e. Kurta Pyjama for boys and Salwar Kurta for girls. However, students can wear appropriate sportswear/yoga dress while playing indoor/outdoor games or attending yoga sessions.
- Use of tobacco in any form and smoking is strictly prohibited in the campus.
- Gambling in any form such as playing cards (even without money at stake), consumption of non-vegetarian foods, eggs, alcohol, tobacco, drugs, and narcotics and even possession of such things are prohibited. Indulging in such activities would attract severe disciplinary action.
- The security guards are for the safety of the students. Students must behave with all security personnel amicably and with due respect. Any misbehavior with the security personnel is punishable. Politeness under all circumstances is imperative.
- A student must furnish his/her identity card when being asked by any authority of the University.

Ragging

Although the word ragging is unheard in the premises of S-VYASA, Ragging in any form (making unpleasant noise, wanton act, vulgar speech/gestures, doing any act which causes or likely to cause physical or psychological harm or raise apprehension or fear of shame or an embarrassment to any student, which include teasing, abusing, playing practical jokes or causing hurt to such students or asking/demanding any student to do any unethical act) is strictly forbidden. If anyone is found guilty of ragging he/she will be expelled and also liable for prosecution. In the matter pertaining to ragging, the victim's complaint is final for taking disciplinary action.

Acts of Indiscipline and Punitive Action

The University has a high-power Disciplinary Committee, which will look into any act of indiscipline action in campus. The action taken by the Disciplinary Committee will be binding and final.

The acts of indiscipline are categorized under the following:

Category I:

- Ragging in any form;
- All acts of violence and all forms of coercion such as gheraos, sit-ins or any variation of the same which disrupt the normal academic and administrative functioning of the University and or any act which incites or leads to violence;
- Gheraos, laying siege or staging demonstrations around the residence of any member of the University/any office of the university or any other form of coercion, intimidation or disturbance of right to privacy of the residents of the campus;
- Sexual harassment of any kind
- Possession and/or consumption of any intoxicant such as tobacco in any form, alcohol, or any other narcotic substance

Category II

- Committing forgery, tampering with the identity Card or University records, impersonation, misusing University property (movable or immovable), documents and records, tearing of pages of defacing, burning or in any way destroying the books, journals, magazines and any material of library or unauthorized photocopying or possession of library books, journals, magazines or any other material. Hunger strikes, dharnas, group bargaining and any other form of protest by blocking entrance or exit of any of the academic and/or administrative complexes or disrupting the movements of any member of the University community.
- Furnishing false certificates, or false information in any manner to the University.
- Any act of moral turpitude;
- Eve-teasing/Adam teasing or disrespectful behavior or any misbehavior with a girl student, women staff member/visitor;
- Arousing communal, caste or regional feelings or creating disharmony among students;
- Use of abusive, defamatory, derogatory or intimidatory language against any member of the University/ Community;
- Causing or colluding in the unauthorized entry of any person into the campus or in the unauthorized occupation of any portion of the University premises; including halls of residence, by any person;

- Unauthorized occupation of the hostel rooms or unauthorized acquisition and use of University furniture in one's hostel room or elsewhere;
- Indulging in acts of gambling in the University premises;
- Consuming or possessing narcotic drugs/ Ganja or other intoxicants in the University premises;
- Damaging or defacing, in any form, any property of the University or the property of any member of the University community;
- Not disclosing one's identity when asked to do so by a faculty member or employee of the University/security personnel who is authorized to ask for such identity;
- Cooking in the hostel premise/campus
- Impropriate behavior while on tour or excursion;
- Any other offence under the law of land;
- Accommodating unauthorized guests or other persons in the hostels;
- Engaging in any attempt at wrongful confinement of any member of the faculty, staff, student or anyone camping inside the campus;
- Any intimidation of or insulting behavior towards a student, staff, or faculty or any other person;
- Any other act which may be an act of violation of discipline and conduct;

Punitive Actions

The high-power disciplinary committee would decide the appropriate punishment as follows:

- Penalty
- Summoning parents and warning
- One-month suspension from the course/hostel/campus
- Six-months suspension from the course/hostel/campus
- Suspension up to two years from the course/hostel/campus
- Expulsion from the program/University with remark on the certificates

Complaints and Suggestions

The University welcomes any complaints, suggestions or inquiries to improve the facilities provided in the campus.

Ph.D. Coursework – Credits and Syllabus

Credits in Ph.D. – Course Work (Computer Science)

Subject Code	Name of the Subject	Credits	Lecture/ Practical (Hrs/week)	Exam in Hrs	IA	Exam
PHRM001	Research Methodology	4	4	3	50	50
PHYG001	Introduction to Yoga Philosophy	4	4	3	50	50
-	Specialisation Paper-I	4	4	3	50	50
-	Specialisation Paper-II	4	4	3	50	50
	Total	**16**	**16**		**50**	**50**

Specialisation Based Courses Offered for Each Discipline Under Computer Science:

AI and ML						
Subject Code	**Name of the Subject**	**Credits**	**Lecture/ Practical (Hrs/week)**	**Exam in Hrs**	**IA**	**Exam**
PHAM101	Artificial Intelligence	4	4	3	50	50
PHAM102	Machine Learning	4	4	3	50	50
PHAM103	Neural Networks and Deep Learning	4	4	3	50	50
PHAM104	Natural Language Processing	4	4	3	50	50

Data Science						
Subject Code	**Name of the Subject**	**Credits**	**Lecture/ Practical (Hrs/week)**	**Exam in Hrs**	**IA**	**Exam**
PHDS101	Data mining and Data warehousing	4	4	3	50	50
PHDS102	Data Compression	4	4	3	50	50

IOT						
Subject Code	**Name of the Subject**	**Credits**	**Lecture/ Practical (Hrs/week)**	**Exam in Hrs**	**IA**	**Exam**
PHIT101	Internet of Things and Applications	4	4	3	50	50
PHIT102	Embedded Computing	4	4	3	50	50
PHIT103	Multicore architecture	4	4	3	50	50
PHIT104	Natural Language and Programming	4	4	3	50	50

Image Processing						
Subject Code	**Name of the Subject**	**Credits**	**Lecture/ Practical (Hrs/week)**	**Exam in Hrs**	**IA**	**Exam**
PHIP101	Image Processing and Computer Vision	4	4	3	50	50
PHIP102	Speech Processing	4	4	3	50	50
PHIP103	Pattern Recognition	4	4	3	50	50

Ph.D. Course Work Syllabus: Computer Science

MANDATORY COURSES

RESEARCH METHODOLOGY								
Course Code	**PHRM001**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	**Introductory knowledge of research fundamentals**							
Course Summary:	The Research Methodology course provides a comprehensive foundation in research principles, covering essential topics such as types of research, data collection and analysis, scientific writing, and research ethics. Students will learn to design, conduct, and document research effectively, utilizing quantitative and qualitative methods while adhering to ethical standards. By the course end, students will be equipped with the skills needed for structured, credible research in academic and professional settings.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Understand the Meaning and Importance of Research
CO2	Identify data sources and classify the types of data.
CO3	Create and interpret statistical graphics
CO4	Understand the structure of scientific report and develop a project proposal
CO5	Understand the Role of Research Ethics Committee and practice ethical citation.

Module – I: Introduction to Research
Introduction to Research: Meaning and importance of Research Types of Research Research Design and Stages Selection and Formulation of Research Problem, Objective(s) and Hypothesis Developing Research Plan – Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Design.
Module – II: Data Collection
Data Collection: Sources of Data – Primary and Secondary Types of Data – Categorical (nominal and ordinal), Numerical (discrete, continuous, ratio and interval) Methods of Data Collection: Survey, Interviews (in-depth or Key Informant interviews), Focus Group Discussion (FGD), Observation, Records or Experimental Observations.
Module – III: Data Processing and Analysis
Data Processing and Analysis: Statistical Graphics – Histograms, Frequency Polygon, Ogive, Dotplots, Stemplots, Bar Graphs, Pareto Charts, Pie Charts, Scatterplots, Boxplots Descriptive Analysis – Frequency Distributions, Measures of Central Tendency, Measures of Variation/Dispersion, Skewness and Kurtosis, Measures of Relative Standing Qualitative Approaches Including Grounded Theory, Ethnography, Narrative Inquiry, Phenomenology and Case-Study.
Module – IV: Scientific Writing

Scientific Writing: Structure and Components of Scientific Reports – Types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, Structure and Language of Typical Reports – Illustrations and Tables – Bibliography, Referencing and Foot Notes. Preparation of the Project Proposal – Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and Work Plan – Budget and Justification – References.

Module – V: Research Ethics

Research Ethics: Research Ethics Committees/Institutional Review Board – Roles and Importance Intellectual Property rights – Commercialization, Royalty Reproduction of Published Material – Citation and Acknowledgement, Plagiarism.

TEXT BOOKS:

1. Research Methodology – C.R.Kothari

2. Dipankar Deb • Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0

3. Intellectual Property A Primer for Academia by Prof. Rupinder Tewari Ms. Mamta Bhardwa.

REFERENCE BOOKS:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488- 4
2. Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

MANDATORY COURSES

INTRODUCTION TO YOGA PHILOSOPHY								
Course Code	**PHYG001**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	**Basic Understanding of Yoga Practice**							
Course Summary:	The goal of teaching Yoga Philosophy to postgraduate students is to give comprehensive knowledge about therapeutic basis of yoga as mentioned in ancient literature including Vedäs, Upanishads, Bhagavad Gita and shat darshanas etc.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Explain the hidden concepts available in the ancient yogic texts
CO2	Understand the yogic principles of Yoga therapy
CO3	Appreciate the contributions of the Yogis
CO4	Understand the fold of afflictions and means to overcome them
CO5	Explain the essence of Vedas and Upanishads

Module – I:

Introduction to Vedas and Upanishads: Historical facts about Vedas: Dating and Authoring of Vedas, Content of Vedas, Vedas in brief: Jnana Kanda – Prasthana Traya – Upanishads and Vedanta Texts (Taittiriya, Katha, Mandukya, Yoga Vasistha), Karma Kanda - Types of Karma, Performance of Karma, Results of Karma, Theory of Karma, Upanishad Prakriyas (10 upanishads teaching techniques) in brief
Module – II:
Yoga Philosophy in Upanishads: Main Human quests: Who am I (Panchakosha Viveka) – Understanding Consciousness through Indian Philosophy, Ananda Mimamsa – Happiness Analysis and MeasuringAnanda – ,Energy Model
Module – III:
Yoga Philosophy in Upanishads: Concept of Dharma – Literal Meaning of Dharma, Nyaya vs Dharma, Varna and Ashrama Dharma – Social Dharma and Life journey, Varna and Ashrama Dharma – Possible conflicts of Dharma and answers
Module – IV:
Darshnas: Astika Darshanas: Sankhya, Yoga, Nyaya, Veisheshika, Mimamsa, Vedanta – Yoga Vasista, Narada Bhakti Sutras Nastika Darshanas, Charvaka, Jaina, Boudha
Module – V:
Bhagavadgita: Concept of Guna, Concept of Yajna, Concept of Atma, Concept of Atma Swaroopa, Concept of Sankhya (Creation), Concept of Sthita Prajna, Concept of Food and its classification, Concept of psycho analysis, Concept of Guna traya Vibhaga and Shraddha traya

TEXT BOOKS:

1. The Vedas - by Chandrasekharendra Saraswati (2014), Bhavan's Publication Bhagavad Gita
2. Yoga its basis and applications - by Dr. H.R. Nagendra – SVYP

REFERENCE BOOKS:

1. Let Go – Discover lasting happiness – Prof A. Satyanarayana Sastry – SVYP
2. Integrated Approach of Yoga Therapy for Positive Health – Dr R Nagaratna and Dr H R Nagendra – SVYP
3. Bhagawat Gita Shatdarshana – Sw Sukhabodhananda – RK Mat publications Narada Bhakti Sutras – Sw Harshananda – RK Mat publications

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: AI and ML

ARTIFICIAL INTELLIGENCE								
Course Code	**PHAM101**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	**Concepts of Data structures and Design and Analysis of algorithms**							
Objective:	• To learn the difference between optimal reasoning VS human like reasoning. • To understand the notions of state space representation and heuristic search. • To learn different knowledge representation techniques. • To understand the applications of AI: namely Game playing, Theorem Proving.Expert systems, machine learning and Natural language Processing.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts/Principles of artificial intelligence.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Apply the Knowledge of probability to understand machine learning algorithms
CO5	Execute/Create the Project or field assignment as per the knowledge gained inthe course

UNIT – I:	**(8 Hours)**
Introduction to Artificial Intelligence, AI Problems, AI Techniques, Problem Space and Search, Defining the problem as a state space search, Production system, Problem characteristics, **Heuristic search Technologies:** Generate and Test, Hill Climbing, Best First Search, Problem Reduction, means- end-analysis, optimal and A*, AND-OR Graphs, AO* Algorithms.	

UNIT – II: **(8 Hours)**
Representation Knowledge using Predicate Logic, Representing simple facts in logic, Representing Instance and ISA relationships, Computable functions and Predicates, Resolution, Representing Knowledge using Rules, Forward Vs Backward Reasoning, Matching , Control Knowledge, , Weak slot and Filter structures, Semantic nets, Frames.
UNIT – III: **(8 Hours)**
Strong slot and Filter structures, Conceptual Dependencies, Scripts. Introduction to Non monotonic reasoning ,Logics for Non monotonic reasoning, Implementation : Depth First Search, Dependency-Directed Back Tracking, Justification based Truth Maintenance Logic based Truth Maintenance systems, Statistical Reasoning, Probability and Bayes Theorem, Certainty factors, Rule based Systems, Bayesian Networks, Dempster-Shaffer Theory.
UNIT – IV: **(8 Hours)**
Minmax search, alpha-beta cutoffs, Planning system, Goal stack planning, Hierarchical Planning, Natural Language Processing., Syntactic Analysis, Semantic Analysis, Discuses and Pragmatic Processing.
UNIT – V: **(8 Hours)**
Introduction and Fundamentals of Artificial Neural Networks, Biological Prototype, Artificial Neuron Single Layer Artificial Neural Networks, Multilayer Artificial Neural Networks, Training of Artificial Neural Networks
TEXT BOOKS: 1. Elaine Rich, Kevin Knight and ShivashankarB . Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008. 2. Neural Computing: Theory and practice- Waserman.

REFERENCE BOOKS:

3. Artificial Intelligence Structures and Strategies complex problem solving-George F. Lugar Pearson Education
4. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
5. Dan W. Patterson, Artificial Intelligence and Expert Systems, PHI.
6. Neural Networks: A Comprehensive Foundation 2/e- Symen Pearson Education.

WEB REFERENCES

1. **http://nptel.ac.in/courses/106106126/**
2. **http://nptel.ac.in/courses/106105079/**

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: AI and ML

MACHINE LEARNING								
Course Code	**PHAM102**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of computer science and mathematics							
Objective:	• To introduce concepts of learning. • To know decision tree learning and various learning methods.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts/Principles of machine learning.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course.
CO5	Remember and understand the basic concepts/Principles of machine learning.

UNIT – I:	**(8 Hours)**
General Introduction: Learning Problems, Choosing Training experience/Target Function, Representation of the target function, issues in machine learning. **Concept Learning:** Concept learning task-Inductive Learning, Concept Learning as search, FIND-S algorithm, version spaces, The List then Eliminate algorithm, Representation of version spaces, The Candidate Elimination algorithm, Inductive bias.	
UNIT – II:	**(8 Hours)**

Decision Tree Learning: Decision tree representation, ID3 Learning algorithm, Entropy, Information gain, over fitting, reduced error pruning, Rule-post pruning.
Bayesian Learning: Bayes' Theorem and concept Learning, Bayes optimal classifier, Bayesian Belief Network.

UNIT – III: **(8 Hours)**

Instance based Learning: Introduction, k-Nearest Neighbor Learning algorithm, distance weighted nearest neighbor learning algorithm, case based reasoning, lazy learner and eager learner.

UNIT – IV: **(8 Hours)**

Learning Set of Rules: Sequential covering algorithm, First Order Inductive Learning (FOIL), Induction as inverted deduction, Inverting resolution (First order resolution), Generalization, theta- subsumption and entailment, PROGOL

UNIT – V: **(8 Hours)**

Analytical Learning: Inductive vs Analytical Learning, Prolog-EBG, Combining inductive and analytical learning.

TEXT BOOKS

Tom M. Mitchell, Machine Learning, Mac Graw Hill

REFERENCE BOOKS:

Christopher M. Bishop, Machine Learning and Pattern Recognition, Springer

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: AI and ML

NEURAL NETWORKS AND DEEP LEARNING								
Course Code	**PHAM103**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of computer science							
Objective:	Introduce major deep learning algorithms, the problem settings, and their applicationsto solve real world problems.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts/Principles of neural networks and deep learning.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Apply the deep learning techniques to the real world problems
CO5	Execute/Create the Project or field assignment as per the knowledge gained in the course.

UNIT – I: **(8 Hours)**
Introduction: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.
UNIT – II: **(8 Hours)**

Feed forward neural network: Artificial Neural Network, activation function, multi-layer neuralnetwork. Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.

UNIT – III: **(8 Hours)**

Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network.

UNIT – IV: **(8 Hours)**

Deep Belief Network, Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.

UNIT – V: **(8 Hours)**

Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing.

Deep Learning Tools: Caffe, Theano, Torch.

TEXT BOOKS

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCE BOOKS:

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: AI and ML

NATURAL LANGUAGE PROCESSING								
Course Code	**PHAM104**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Artificial Intelligence							
Objective:	The course aimTo introduce concepts of learning and to know decision tree learning and various learning methods.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts/Principles of natural language processing.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Apply NLP techniques to real time applications
CO5	Execute/Create the Project or field assignment as per the knowledge gained inthe course.

UNIT – I: **(8 Hours)**
Basic Probability & Information Theory: Introduction to NLP, Main Issues, Basics on Probability Theory, Elements of Information Theory, Language Modeling in General and Noisy Channel Model, Smoothing and EM Algorithm.
UNIT – II: **(8 Hours)**

Linguistics: Phonology and Morphology, Syntax (Phrase Structure vs. Dependency). Words & Lexicon: Word Classes and Lexicography, Mutual Information, The t-score, The Chi-square Test, Word Classes for NLP Tasks, Parameter Estimation, Partitioning Algorithm, Complexity Issues of Word Classes, Programming Tricks & Tips.

UNIT – III: **(8 Hours)**

Hidden Markov Models & Tagging: Markov Models, Hidden Markov Models (HMMs), TrellisAlgorithm, Viterbi Algorithm. Estimating the Parameters of HMMs, The Forward-Backward Algorithm, Implementation Issues, Task of Tagging, Tag sets, Morphology, Lemmatization, Tagging Methods, Manually Designed Rules and Grammars, Statistical Methods, HMM Tagging (Supervised, Unsupervised), Evaluation Methodology (examples from tagging), Precision, Recall, Accuracy, Statistical Transformation Rule-Based Tagging, Maximum Entropy, Maximum Entropy Tagging, Feature Based Tagging, Results on Tagging, Various Natural Languages.

UNIT – IV: **(8 Hours)**

Grammars & ParsingAlgorithms: Introduction to Parsing, Generative Grammars, Properties of Regular and Context-free Grammars, Overview on Non-statistical Parsing Algorithms, Simple Top- Down Parser with Backtracking, Shift-Reduce Parser, Tree banks and Tree banking, Evaluation of Parsers, Probabilistic Parsing. PCFG: Best Parse, Probability of String.

UNIT – V: **(8 Hours)**

Statistical Parsing & Machine Translation: Lexicalized PCFG, Statistical Machine Translation (MT), Alignment and Parameter Estimation for MT.Deep Learning Tools: Caffe, Theano, Torch.

TEXT BOOKS

1. Foundations of Statistical Natural Language Processing, Manning, C. D. and H. Schutze, The MIT Press.

REFERENCE BOOKS:

1. Speech and Language Processing, Juraf sky, D. and J. H. Martin, Prentice-Hall.
2. Natural Language Understanding, Allen, J., The Benajmins/Cummings Publishing Company Inc.
3. Elements of Information Theory, Cover, T. M. and J. A. Thomas, Wiley.

4. Statistical Language Learning, Charniak, E., The MIT Press.
5. Statistical Methods for Speech Recognition, Jelinek, F., The MIT Press.

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: DATA SCIENCE

DATA MINING AND DATA WAREHOUSING								
Course Code	**PHDS101**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Core Course							
Prerequisite:	Data Structure and Algorithm, Linear Algebra, Basics of Web programming							
Objective:	This course deals with evolving multidimensional intelligent model from a typical system, representation of multi-dimensional data for a data warehouse, discovering the knowledge imbibed in the high dimensional system, finding the hidden interesting patterns in data, and gives the idea to evaluate various mining techniques on complex data objects.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts/Principles of data warehousingand data mining
CO2	Analyse the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems.
CO4	Analyse the concepts of the various statistical techniques
CO5	Execute/Create the Project or field assignment as per the knowledge gained in the course.

UNIT – I: (8 Hours)
INTRODUCTION TO DATA WAREHOUSING AND ARCHITECTURE: Evolution of Decision Support Systems- Data warehousing Components –Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact constellations
UNIT – II: (8 Hours)
DATA WAREHOUSE PROCESSAND ARCHITECTURE: Types of OLAP servers, 3–Tier data warehouse architecture, distributed and virtual data warehouses. Data warehouse implementation, tuning and testing of data warehouse. Data Staging (ETL) Design and Development, data warehouse visualization, Data Warehouse Deployment, Maintenance, Growth, Business Intelligence Overview- Data Warehousing and Business Intelligence Trends - Business Applications
UNIT – III: (8 Hours)
INTRODUCTION TO DATA MINING AND CLASSIFICATIONS Data mining-KDD versus data mining, Stages of the Data Mining Process-task primitives, Data Mining Techniques -Data mining knowledge representation – Data mining query languages, Integration of aData Mining System with a Data Warehouse – Issues, Data preprocessing – Data cleaning, Data transformation, Feature selection, Dimensionality reduction, Discretization and generating concept hierarchies-Mining frequent patterns- association-correlation
UNIT – IV: (8 Hours)
Decision Tree Induction - Bayesian Classification – Rule Based Classification –Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods.
UNIT – V: (8 Hours)

CLUSTERING,ADVANCES IN DATA MINING (10 Hours)

Clustering techniques – , Partitioning methods- k-means Hierarchical Methods - distance-based agglomerative and divisible clustering, Mining complex data objects, Spatial databases, temporal databases, Multimedia databases, Time series and Sequence data; Text Mining –Graph mining-web mining-Application and trends in data mining.

TEXT BOOKS:

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, MorganKaufmann Publishers, third edition2011, ISBN: 1558604898.
2. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGrawHill Edition, Tenth Reprint 2007.
3. G. K. Gupta, "Introduction to Data Min Data Mining with Case Studies", EasterEconomy Edition, Prentice Hall of India, 2006.

REFERENCE BOOKS:

1. Mehmed kantardzic,"Datamining concepts, models, methods, and algorithms", Wiley Interscience, 2003.
2. Ian Witten, Eibe Frank, Data Mining; Practical Machine Learning Tools and Techniques, third edition, Morgan Kaufmann, 2011.
3. George M Marakas, Modern Data Warehousing, Mining and Visualization, Prentice Hall,2003.

WEB REFERENCES

1. http://www.data-miners.com/

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE

SUB-DOMAIN: DATA SCIENCE

DATA COMPRESSION								
Course Code	**PHDS102**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of Data Analytics							
Objective:	Learning concepts of Data compression Techniques							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts of Data compression techniques
CO2	Understand the basic concepts of Huffman coding techniques
CO3	Apply the knowledge and understanding the wavelet transform techniques
CO4	Understand the Image compression techniques
CO5	Understand the Video compression techniques

UNIT – I: **(8 Hours)**
Introduction: Compression techniques, modeling and coding mathematical preliminaries for lossless compression: A brief introduction to information theory, models, coding, algorithmic information theory, minimum description length principle.
UNIT – II: **(8 Hours)**
Huffman Coding: The Huffman coding algorithm, non binary Huffman codes, adaptive Huffman coding, golomb codes, rice codes, Tunstall codes, application of Huffman coding.
UNIT – III: **(8 Hours)**

Lossless Image Compression: Introduction, CALIC, JPEG-LS, multi resolution approaches, facsimile encoding, MRC-T.44. Mathematical Preliminaries For Lossy Coding:= Introduction, distortion criteria, information theory revisited, rate distortion theory, models.
UNIT – IV: (8 Hours)
Wavelet Based Compression: Introduction, wavelets, multi resolution analysis and scaling function, implementation using filters, image compression, embedded zero tree coder, set partitioning in hierarchical trees, JPEG zero. Audio Coding:Introduction , MPEG coding, MPEG advanced audio coding, Dolby AC3(DOLBY DIGITAL) other standards.
UNIT – V: (8 Hours)
Video Compression: Introduction, motion compensation, video signal representation, ITU-T recommendation H.261, model based coding, asymmetric applications, The MPEG-1 video standard, The MPEG-2 video standard, ITU-T recommendation H.263, ITU-T recommendation H.264, MPEG-4 part 1.0 advanced video coding, MPEG-4 part 2 , packet video, ATM networks
TEXT BOOKS Sayood, Khalid. Introduction to data compression. Morgan Kaufmann, 2017.
REFERENCE BOOKS: Compression, Data. "The Complete Reference. David Salomon (with contributions by Giovanni Motta and David Bryant)."

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE

SUB-DOMAIN: IOT

INTERNET OF THINGS AND APPLICATIONS								
Course Code	**PHIT101**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	**Fundamentals of Microcontrollers**							
Objective:	Learn about IOT Ecosystems, Main Components like Sensors and Acctuators							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts of IOT
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Apply the Knowledge of IOT to design an automations problems
CO5	Execute/Create the Project or field assignment as per the knowledge gained inthe course

UNIT – I:	**(8 Hours)**
What is The Internet of Things? Overview and Motivations, Examples of Apllications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication Examples-Overview, Smart Metering/Advanced Metering InfrastructureHealth/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications	

UNIT – II:	**(8 Hours)**
Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards- Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO.	
UNIT – III:	**(8 Hours)**
Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity: IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.	
UNIT – IV:	**(8 Hours)**
Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.	
UNIT – V:	**(8 Hours)**
Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Realtime Data Analysis, Structural Health Monitoring Case Study.	

TEXT BOOKS:

4. Minoli, Daniel. *Building the internet of things with IPv6 and MIPv6: The evolving world of M2M communications*. John Wiley & Sons, 2013.
5. Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach. Vpt, 2014.

REFERENCE BOOKS:

1. Miller, Michael. The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world. Pearson Education, 2015.
2. Rowland, Claire, et al. Designing connected products: UX for the consumer Internet of Things. " O'Reilly Media, Inc.", 2015.

WEB REFERENCES

3. **http://nptel.ac.in/courses/106106126/**
4. **http://nptel.ac.in/courses/106105079/**

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: IOT

EMBEDDED COMPUTING								
Course Code	**PHIT102**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of embedded concepts							
Objective:	Learning concepts of Embedded systems							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts of Embedded systems
CO2	Understand the basic concepts of Communication devices
CO3	Apply the knowledge in understanding practical problems.
CO4	Understand the Interupt concepts and device drivers
CO5	Remember and understand the concepts of real time Operating systems

UNIT – I: **(8 Hours)**

Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.

UNIT – II: **(8 Hours)**

Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols-parallel communication internet using ISA, PCI, PCI-X and advanced buses, Internet enabled systems network protocols, Wireless and mobile system protocols.

UNIT – III: (8 Hours)

Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming.

UNIT – IV: (8 Hours)

Inter process communication and synchronization of processes, Threads and tasks: Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Inter-process communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.

UNIT – V: (8 Hours)

Real-time operating systems: OS Services, Process management, Timer functions, Event functions, Memory management, Device, file and IO subsystems management, Interrupt routines in RTOS environment and handling of interrupt source calls, Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software.

TEXT BOOKS

Kamal. Embedded Systems: Architechture, Programming and Design. McGraw-Hill Science/Engineering/Math, 2006

REFERENCE BOOKS:

Gvero, Igor. "Computers as components: principles of embedded computing system design by Marilyn Wolf." ACM SIGSOFT Software Engineering Notes 38.5 (2013): 67-68.

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: IOT

Course Code	**PHIT103**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of computer science							
Objective:	Introduce major deep learning algorithms, the problem settings, and their applicationsto solve real world problems.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts of computer technology
CO2	Analyse the Various Concepts to understand the concepts of Parallel Programming
CO3	Apply the knowledge to understand the multicore processors
CO4	Understand the basic concepts of Data loop.
CO5	Understand the concepts of Common parallel Programming

UNIT – I:	**(8 Hours)**
Classes of Computers, Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance. Single core to Multi-core architectures: Limitations of Single Core Processors - The Multi core era – Case Studies of Multi core Architectures. System Overview of Threading: Defining Threads, System View of Threads,	

Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading.
UNIT – II: (8 Hours)
Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data 20082020 / 37 Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion. Threading and Parallel Programming Constructs: Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).
UNIT – III: (8 Hours)
TLP AND MULTIPROCESSORS : Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues -Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Network
UNIT – IV: (8 Hours)
A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Datarace Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Singlethread and Multi-thread Execution. OpenMP: OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.
UNIT – V: (8 Hours)
Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging,

Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture.

TEXT BOOKS

1. Akhter, Shameem, and Jason Roberts. Multi-core programming. Vol. 33. Hillsboro, Oregon: Intel press, 2006.
2. Pacheco, Peter. An introduction to parallel programming. Elsevier, 2011.
3. Gove, Darryl. Multicore Application Programming: For Windows, Linux, and Oracle Solaris. Addison-Wesley Professional, 2010.

REFERENCE BOOKS

1. Quin, M. "parallel programming in Cwith MPI and OpenMP." Tata McGraw Hills edition (2000).

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: IOT

NATURAL LANGUAGE PROCESSING								
Course Code	**PHIT104**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Artificial Intelligence							
Objective:	• To introduce concepts of learning. • To know decision tree learning and various learning methods.							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts/Principles of natural language processing.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Apply NLP techniques to real time applications
CO5	Execute/Create the Project or field assignment as per the knowledge gained inthe course.

UNIT – I: **(8 Hours)**
Basic Probability & Information Theory: Introduction to NLP, Main Issues, Basics on Probability Theory, Elements of Information Theory, Language Modeling in General and Noisy Channel Model, Smoothing and EM Algorithm.
UNIT – II: **(8 Hours)**

Linguistics: Phonology and Morphology, Syntax (Phrase Structure vs. Dependency). Words & Lexicon: Word Classes and Lexicography, Mutual Information, The t-score, The Chi-square Test, Word Classes for NLP Tasks, Parameter Estimation, Partitioning Algorithm, Complexity Issues of Word Classes, Programming Tricks & Tips.

UNIT – III: **(8 Hours)**

Hidden Markov Models & Tagging: Markov Models, Hidden Markov Models (HMMs), TrellisAlgorithm, Viterbi Algorithm. Estimating the Parameters of HMMs, The Forward-Backward Algorithm, Implementation Issues, Task of Tagging, Tag sets, Morphology, Lemmatization, Tagging Methods, Manually Designed Rules and Grammars, Statistical Methods, HMM Tagging (Supervised, Unsupervised), Evaluation Methodology (examples from tagging), Precision, Recall, Accuracy, Statistical Transformation Rule-Based Tagging, Maximum Entropy, Maximum Entropy Tagging, Feature Based Tagging, Results on Tagging, Various Natural Languages.

UNIT – IV: **(8 Hours)**

Grammars & ParsingAlgorithms: Introduction to Parsing, Generative Grammars, Properties of Regular and Context-free Grammars, Overview on Non-statistical Parsing Algorithms, Simple Top- Down Parser with Backtracking, Shift-Reduce Parser, Tree banks and Tree banking, Evaluation of Parsers, Probabilistic Parsing. PCFG: Best Parse, Probability of String.

UNIT – V: **(8 Hours)**

Statistical Parsing & Machine Translation: Lexicalized PCFG, Statistical Machine Translation (MT), Alignment and Parameter Estimation for MT.Deep Learning Tools: Caffe, Theano, Torch.

TEXT BOOKS

2. Foundations of Statistical Natural Language Processing, Manning, C. D. and H. Schutze, The MIT Press.

REFERENCE BOOKS:

1. Speech and Language Processing, Juraf sky, D. and J. H. Martin, Prentice-Hall.
2. Natural Language Understanding, Allen, J., The Benajmins/Cummings Publishing Company Inc.
3. Elements of Information Theory, Cover, T. M. and J. A. Thomas, Wiley.

4. Statistical Language Learning, Charniak, E., The MIT Press.
5. Statistical Methods for Speech Recognition, Jelinek, F., The MIT Press.

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: IMAGE PROCESSING

IMAGE PROCESSING AND COMPUTER VISION								
Course Code	**PHIP101**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	**Basics of Image processing techniques**							
Objective:	• Learn Different concepts of computer vision techniques							

Course Outcomes: On completion of the course, the student will be able to

CO1	Remember and understand the basic concepts of digital image fundementals
CO2	Analyse the Various Concepts to understand them through image enhancement techniques
CO3	Apply the knowledge in understanding image restoration techniques
CO4	Apply the Knowledge of image processing techniques for different types of data
CO5	Understand the basic concepts of computer vision techniques

UNIT – I: (8 Hours)
Introduction and Digital Image Fundamentals Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels.
UNIT – II: (8 Hours)
Image Enhancement in the Spatial and Frequency Domain Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Grey Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.
UNIT – III: (8 Hours)
Image Restoration and Image Compression Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear PositionInvariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.
UNIT – IV: (8 Hours)
Image Segmentation and Morphological Image Processing Discontinuity based segmentation, Similarity based segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms.
UNIT – V: (8 Hours)

Object Representation and description and Computer Vision Techniques Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications.

TEXT BOOKS:

1. Gonzalez, Rafael C. Digital image processing. Pearson education india, 2009.
2. Forsyth, David A., and Jean Ponce. Computer vision: a modern approach. prentice hall professional technical reference, 2002.
3. Jain, Anil K. Fundamentals of digital image processing. Prentice-Hall, Inc., 1989.

REFERENCE BOOKS:

7. Artificial Intelligence Structures and Strategies complex problem solving-George F. Lugar Pearson Education
8. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
9. Dan W. Patterson, Artificial Intelligence and Expert Systems, PHI.
10. Neural Networks: A Comprehensive Foundation 2/e- Symen Pearson Education.

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: IMAGE PROCESSING

SPEECH PROCESSING								
Course Code	**PHIP102**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of computer science and mathematics							
Objective:	• To acquire the fundamentals of the digital signal processing that allows them to assimilate the concepts related to the speech processing. • To introduce the fundamentals of speech signal processing. • To present basic principles of speech analysis. To give an overview of speech processing applications including speech enhancement, speech recognition and speaker recognition							

Course Outcomes: On completion of the course, the student will be able to

CO1	Understand the mechanism of human speech production and digital models of speech signals
CO2	Apply standard digital signal processing tools to analyze speech signals in terms of their Time and frequency domain representations.
CO3	Understand Linear Predictive analysis of speech signal and different pitch period estimation methods
CO4	Understand the Homomorphic processing of speech signal and applications of speech processing, including speech enhancement
CO5	Understand the applications of speech processing including speaker recognition and speech recognition.

UNIT – I: (8 Hours)
Introduction, Fundamentals of Digital Speech Processing
UNIT – II: (8 Hours)
Digital models for the speech signals, Time domain models for speech processing
UNIT – III: (8 Hours)
Digital representation of the speech waveform, short term Fourier analysis.
UNIT – IV: (8 Hours)
Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Computation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.
UNIT – V: (8 Hours)
Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications Digital speech for man machine communication by voice.
TEXT BOOKS Rabiner, Lawrence R. Digital processing of speech signals. Pearson Education India, 1978.
REFERENCE BOOKS: Gold, Ben, Nelson Morgan, and Dan Ellis. Speech and audio signal processing: processing and perception of speech and music. John Wiley & Sons, 2011.

SPECIALISATION BASED COURSES OFFERED FOR EACH DISCIPLINE UNDER COMPUTER SCIENCE
SUB-DOMAIN: IMAGE PROCESSING

PATTERN RECONGINTION								
Course Code	**PHIP103**	**L-P-T-Cr.:**	**4**	**0**	**0**	**4**	**Semester:**	**I**
Category:	Programme Elective Course							
Prerequisite:	Fundamental of computer science							
Objective:	To understand the concept of pattern and the basic approach in developing pattern recognition algorithms To develop prototype pattern recognition algorithms that can be applied against real-world multivariate data To effectively implement pattern recognition algorithms for specific applications using simulation tools							

Course Outcomes: On completion of the course, the student will be able to

CO1	Able to apply the knowledge of mathematics for obtaining solutions in pattern recognition domain.
CO2	Able to apply various algorithms for pattern recognition
CO3	Able to map the pattern recognition concepts for solving real life problems
CO4	Able to carry out implementation of algorithms using different simulation tools
CO5	Execute/Create the Project or field assignment as per the knowledge gained in the course.

UNIT – I: (8 Hours)
Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems.
UNIT – II: (8 Hours)
Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.
UNIT – III: (8 Hours)
Nearest Neighbour based classifiers & Bayes classifier: Nearest neighbour algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network.
UNIT – IV: (8 Hours)
Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM.
UNIT – V: (8 Hours)
Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, kmeans, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition.
TEXT BOOKS 1. Murty, M. Narasimha, and V. Susheela Devi. Pattern recognition: An algorithmic approach. Springer Science & Business Media, 2011. 2. Gose, Earl, Richard Johnsonbaugh, and Steve Jost. Pattern recognition and image analysis. Prentice-Hall, Inc., 1996.

REFERENCE BOOKS:

1. Duda, R. O., et al. Pattern classification, chapter nonparametric techniques. Wiley-Interscience Publication,, 2000.