Regulation for the Degree of Doctor of Philosophy Programme - 2012

With Amendments Approved in 7th, 8th & 9th Senate

Regulation

for

The Degree of

Doctor of Philosophy (Ph. D.) Programme

2012

(With amendments approved in 7th, 8th & 9th Senate)

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NATIONAL INSTITUTE OF TECHNOLOGY PATNA

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VISION

To contribute to India and the World through excellence in scientific and technical education and research; to serve as a valuable resource for industry and society; and to remain a source of pride for all Indians.

MISSION

To generate new knowledge by engaging in cutting-edge research and to promote academic growth by offering state-of-the-art undergraduate, postgraduate and doctoral programmes.

To identify, based on an informed perception of Indian, regional and global needs, areas of specialization upon which the Institute can concentrate.

To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry.

To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

VALUES

- *Academic integrity and accountability.*
- *Respect and tolerance for the views of every individual.*
- *Attention to issues of national relevance as well as of global concern.*
- *Breadth of understanding, including knowledge of the human sciences.*
- *Appreciation of intellectual excellence and creativity.*
- *An unfettered spirit of exploring, rationality and enterprise.*

REGULATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (Ph. D.)

1. GENERAL

1.1. The Institute provides facilities for research leading to the award of Degree of **Doctor of Philosophy (Ph. D.)** in the areas related to Engineering, Technology, Architecture, Science, Management, Humanities and Allied disciplines.

1.2. Ph. D Programme is a residential Programme to be carried out at NIT Patna Campus under guidance of faculty of the Institute. In special cases joint guides/ Supervisors/ Co-supervisor from outside the Institute may be allowed.

1.3. The regulation herein specified applies to Full-time (Regular/ Sponsored), Part-time: Sponsored (Internal/ External) category of candidates.

1.4. Full-time Programme are those Programmes where the participants devote their entire available time for the studies and research work as per schedule and not employed, except in the case of sponsored candidates.

1.5. Part-time Programmes are those Programmes where the participants are employed and where they devote only Part of time for the studies and research work as per schedule at the Institute.

1.6. Sponsored programmes are those programmes which are specific Research programmes designed as per needs of the sponsoring Agency for defined period and group of Participants.

1.7. Collaborative Programme/ Collaborative exchange programmes are those Programmes where the participants pursue any Programme of studies, approved by the Departmental Research committee (DRC) of the Institute either fully or Partly in Indian/ Foreign Institute with whom an appropriate MOU/ similar agreement has been signed by the Institute. The Collaborating Institute where participant(s) pursue partly/ fully any Programme of studies will be known as the Host Institute(s).

1.8. The Registrar of the Institute shall invite applications for admission to the Ph. D. Programme once in a year in the month of May for the coming academic session. A candidate desirous of pursuing Ph. D. Programme at NIT Patna shall apply in the prescribed form, if he/ she satisfy the different criteria detailed in the regulation for Ph. D. Programme.

1.9. Equivalence of the degree shall be solely determined by either the appropriate national professional bodies or with the classification followed by Association of Indian Universities.

1.10. A participant of the Programme is a student who registers himself/ herself with the Institute for a course of study and attends the same. The award of the Ph. D. Degree is made on the basis of satisfactory performance of an enrolled/ registered candidate in

(i) Prescribed course work & seminar,

(ii) Thesis submitted by the candidate and

(iii) Final viva voce.

The thesis shall be the report of research work characterized by either discovery of new facts or a new interpretation of known facts and theory or an independent design and development, or development of new instrument/ technology.

1.11. **Departmental Research Committee (DRC)** constituted as per Appendix - I shall

1.11.1. Scrutinize applications received by the Registrar.

1.11.2. Recommend the name of candidate(s) to be enrolled to the Ph.D. Programme in the Department/ Centre on the basis of overall academic career, test and/ or interview as per weightage detailed in Appendix –II.

1.11.3. The distribution of weightage for different components may be revised/ modified with the approval of the Senate.

1.11.4. Establish equivalence of the degree with those specified under clause 3.2.

1.12. **Doctoral Scrutiny Committee (DSC)** with **Departmental Research Committee** constituted as per appendix –I shall

1.12.1. Monitor the candidate's progress and conduct the seminars

1.12.2. Recommend the names of the examiners for evaluation of the thesis.

1.12.3. On receiving satisfactory reports on the thesis from the examiners, the DSC along with an additional examiner (internal or external) will conduct the final viva voce examination and shall recommend to the Senate for award of the degree.

2. TIME LIMITS FOR Ph. D. PROGRAMME

2.1. Normally all Full-time/ Part-time candidates have to **devote at least three years** including period for course work and research. The period will be counted **from the date of provisional enrolment** to the Programme.

2.2. A candidate may submit Thesis **only after Two years** of his/her registration for Ph. D. Programme. This period shall **start from the date of registration** i.e. on successful completion of assigned course work and approval of research proposal seminar presentation.

2.3. All Full-time/ Part-time candidates are required to devote **minimum one semester for Course work and preparation for research proposal,** however in case of Part-time candidates this period **may be extended up to two years** from the date of enrolment to the Programme depending on their progress report evaluated by DRC.

2.4. A full-time candidate may be allowed to convert his/ her category of admission from Full-time to Part-time **only after completion of one year** on recommendation of DRC.

2.5. Summary of time limits for different activities such as enrolment, academic evaluation, Registration seminar, thesis pre- submission seminar etc are detailed at Appendix – III for reference.

3. ADMISSION

The admission of candidate to the Ph.D. Program is recommended by the Departmental Research Committee abbreviated as DRC, of the Department/ Centre concerned on the basis of admission procedure detailed at Appendix – II.

3.1 CATEGORIES:

The candidate shall be admitted to the Ph. D. Programme under following categories:

3.1.1. **Full Time Regular**: A student in this category works full-time for his/ her Ph. D. degree. He/ She receives assistantship from the Institute or fellowship from CSIR/ UGC or any other recognized funding agency.

3.1.2. **Full Time Sponsored**: A candidate in this category is sponsored by recognized R&D organization, academic institution, government organization or industry for doing research in the Institute on full-time basis. He/ she must be a regular employee of the sponsoring organization with at least **one year of professional experience** in relevant field. The Institute does not provide any assistantship/ fellowship to such candidate.

3.1.3. **Part Time Self Sponsored (Internal)**: A candidate in this category will be an employed person of NIT Patna who is desirous of pursuing Ph. D. Programme simultaneously while discharging the duties of his/ her services. He/ she must be a regular employee of the Institute. The Institute does not provide any assistantship/ fellowship to such candidate.

3.1.4. **Part Time Self Sponsored (External)**: This category refers to the candidates employed in R&D organization/ academic institution/ Industry having adequate research facilities. The research work leading to the Ph. D. Degree shall be carried out largely in the parent organization but with overall guidance provided by faculty member (Institute Supervisor) of the department in which he/ she is enrolled. He/ she must be a regular employee of the sponsoring organization with at least two years of professional experience in the relevant field. The Institute does not provide any assistantship/ fellowship to such candidate.

3.2 ELIGIBILITY CRITERIA FOR SELECTION:

Candidates with following qualification shall be eligible for admission to the Ph. D. Programme of the Institute.

3.2.1 **For Engineering, Technology and Architecture Departments:**

(a) Candidates possessing **M. Tech/ M. E/ M. Sc. (Engg.)/ M. Arch or equivalent Degree in relevant branch** from a recognized University/ Institute **with minimum 60% marks (or a CGPA of 6.5 in 10 point scale)** in the qualifying examination shall be considered for admission in the departments as per their Specialization only.

(b) Candidates possessing **B. Tech/ B. E/ B. Sc. (Engg.)/ B. Arch or equivalent Degree in relevant branch** from a recognized University/ Institute with **minimum 75% marks (or a CGPA of 8.25 in 10 point scale) in all (from 10th onward) examinations including qualifying examination** may be considered **in exceptional cases** after approval of DRC. Such candidates **must have professional/ research experience of at least ten years** in reputed Institutions/ Organizations.

3.2.2 **For Science Departments**:

Candidates possessing **Master's Degree in the area of Science** from a recognized University/ Institute **with minimum 60% marks (or a CGPA of 6.5 in 10 point scale)** in the qualifying examinations shall be considered for admission in the departments as per their Specialization only.

3.2.3 **For Science, Humanities & Social Science Departments**[1]:

Candidates possessing **Master's Degree in the area of English or Economics** from a recognized University/ Institute with minimum 60% marks (or a CGPA of 6.5 in 10 point scale) in the qualifying examinations shall be considered for admission in the departments as per their Specialization only.

3.3 RELAXATION FOR SC/ ST CANDIDATES

Eligibility criteria will be relaxed by 5% marks or 0.5 CGPA for SC/ ST candidates.

3.4 RESERVATIONS

The reservation of seats in admissions for SC, ST categories and Persons with Disability / handicapped i.e. physically challenged (PH) categories will be as per Government of India rules.

3.5 MEDICAL FITNESS

A candidate should fulfill the appropriate standards of medical fitness. The Institute Medical Board's opinion with regard to the medical fitness of a candidate shall be final and binding. In case a candidate is found not to be medically fit his/ her enrolment shall be cancelled without assigning any further reasons.

4. ENROLMENT:

A candidate after selection to the Ph. D. Programme shall be **provisionally enrolled** in the Department/ Centre.

The candidate is required to enroll himself/ herself for the Ph.D. Programme within one month of joining on payment of prescribed fees as shown in Appendix – VIII and to carry out research work under a Supervisor(s) as per guidelines detailed in Appendix – IX from amongst the faculty of the Institute and/ or from other Institute/ R&D organization.

5. COURSE WORK:

5.1 The Departmental Research Committee shall recommend course work for different categories of candidates enrolled in the department/ Centre in consultation of the Supervisor(s).

1 Vide amendment approved in the 8th Senate meeting held on 02.04.2011

5.2 The Course details, minimum class hour requirement, credits etc for any candidate shall be proposed by the Supervisor for approval of DRC.

5.3 The course(s) may be arranged in the department/ centre as per requirement of the proposed area of research. In case the proposed area of research requires courses from other department, then same shall be arranged by the department.

5.4 If Departmental Research Committee considers necessary, the candidate may be directed to pursue all/ some of the courses in other departments of the institute/ Centre and/ or at other Institute/ Universities of India or outside India. However, the financial expenditure involved in such arrangement shall be the candidate's responsibility.

5.5 The evaluation of courses offered within the Institute shall be done as per academic calendar and examination system of the Institute. If any of the course has been completed at other Institute (*Within India or Outside India*), then the candidate is required to give seminar on the Course/ subject to an open audience and in presence of DRC and DSC members for evaluation and satisfactorily completion.

5.6 For the **candidate possessing Master's Qualification**, the course work shall be research methodology course and courses from appropriate Masters or equivalent level Programme and should complete **a minimum of 16 credits of course work out of which a maximum of 4 credits can be for laboratory course**.

5.7 A **candidate possessing Bachelor's qualification** is required to enroll for the appropriate Masters or equivalent level course and complete **a minimum of 24 credits, out of which a maximum of 4 credits can be for laboratory course**.

5.8 If a proposed course is not available in the existing curricula, instructions in the subject then shall be imparted in '**Self–study style'** following all steps like assignments, examination etc. as prescribed for a regular course.

5.9 **Candidates must obtain minimum grade "C" in each of the subjects of assigned course work, under ten point scale system**.

5.10 In case, the candidate **fails to clear the course work within one year of enrolment**, the **DSC/ DRC may review the performance of the candidate** and **may recommended a change of course work**.

6. REGISTRATION:

6.1 Registration for the Ph. D. Programme shall be allowed only after successful completion of the course work.

6.2 The registration seminar should normally be held within **one calendar year of enrolment of a student** who has been admitted on the basis of category of enrolment and qualification as given in clause 3.1 and 3.2 respectively.

6.3 A candidate is required to give a seminar on the topic of his research **within one year of enrolment or within one year/ two years of completion of the course work** as the case may be for Full-time/ Part-time candidates respectively.

6.4 The seminar talk will be delivered to an open audience with members of the DSC and DRC present. If the seminar is satisfactory then candidate will be allowed to register for the Ph. D. Programme. However, **if the DSC and DRC is not satisfied** by the seminar talk, the candidate will be **required to deliver another talk** with suitable **modification or improvement within next three months**.

6.5 If a candidate fails **to clear the registration seminar even on second attempt** the **enrolment shall be cancelled** and the student shall be asked to leave the programme.

6.6 **Registration of a candidate for the Ph.D. Programme shall be effective, from the date of enrolment and shall remain valid for five years for Full-time and six years for Part-time candidates.**

6.7 In the event of a candidate failing to submit his thesis within the maximum period allowed for completing research work, then DRC may recommend for extension of registration (Based on progress of the research work) by one/ two year(s) to the Director/ the Senate. Thereafter no

further extension shall be allowed, and candidate's registration shall stand cancelled automatically.

7. SEMINAR AND SYNOPSIS OF RESEARCH WORK

7.1 **Prior to submission of the thesis** the candidate will submit the **synopsis of the thesis and present a seminar before the DSC and DRC member**.

7.2 The seminar lecture delivered by a candidate will be judged for the candidate's depth of knowledge and progress in his/ her research by DSC. The candidate shall be allowed to submit his/ her thesis for the Ph.D. degree only when the DSC is satisfied about the work.

7.3 If the DSC is not satisfied with the quality of the work and the general preparation of the candidate, the candidate will have to **appear again for the seminar within a maximum period of six months**.

7.4 The candidates enrolled for the Ph. D. Programme are ***required to publish their research work in International and/ or National level Journals of repute and also present research findings at International/ National level conferences from time to time***.

7.5 It is expected that the candidate must have ***at least one publication in refereed International Journal or have been accepted for publication in the International Journal and/ or minimum two papers in refereed National Journal of repute at the time of pre-submission seminar presentation*** for acceptance of thesis for evaluation before the DSC and DRC members.

7.6 The thesis must be **submitted within two months after the DSC's** approval based on pre submission seminar.

8. THESIS

8.1 A candidate may submit his/ her **thesis for Ph. D Degree** after **a minimum period of two years from the date of Registration.**

8.2 A candidate shall **submit five copies of the theses** on A4 size paper, in case of single supervisor and **six copies if there is a joint supervisor**, neatly typed or printed and bound in a manner notified separately .The thesis must contain, besides the text and common matters like bibliography/ reference and summary/conclusions.

(i) The candidate shall submit a declaration that "*the thesis is his/ her own original work and that it has not been presented and will not be presented to any other University/ Institute for a similar or any other Degree award*".

(ii) An abstract of the thesis (about 500 words) with key words (about 20)

(iii) A certificate from the supervisor(s) that (a) the work has been carried our under his/ her/ their supervision, (b) the candidate has fulfilled all prescribed requirements and (c) the thesis is based on candidate's own work and has not been submitted elsewhere for a degree/ diploma.

(iv) The details of Thesis Format guidelines with respect to certificate(s), Chapter's content and outlines etc are available at Appendix – X for reference.

8.3 On successful completion of the seminar the DSC will recommend to **the Senate a panel of six experts, from India and/or abroad to examine the thesis (not more than <u>four</u> experts in the list shall be from India)**.

8.4 **Three experts** from the panel shall be **appointed as 'external' examiners** and the supervisor(s) will be the internal examiner. The thesis shall be forwarded to all the examiners who shall report separately on the thesis and forward their recommendation to the Deputy Registrar (Examination)/ Controller of Examination or any other competent authority.

8.5 The Dean (Academics) will examine the reports of the examiners and send it to the Director-cum-Chairman, Senate. The reports shall thereafter be sent to the DSC for their perusal and necessary action. There may be **four possible situations arising out of the nature of the reports**, and the steps to be taken appropriate to the circumstance shall be as laid down below.

i) The majority of the external examiners (***all or minimum two out of three***) are unanimous in recommending the award of the degree on the basis of the thesis without any modification. This is a clear case for going in for the final requirement of viva voce examination.

ii) The external examiners are unanimous in recommending the award of the degree but **have suggested modification and/ or have asked for clarifications**. The candidate in that case shall make modifications and provide the clarifications as suggested within the time period to be fixed by the DSC which in no case shall exceed six months from the date the communication is sent to the candidate. These modified report(s) may be sent to the examiners, if so desired by them.

iii) One of the external examiners does not recommend the award of the degree and rejects the thesis while the other external examiner ***(two or one***) ***recommends for modification*** before award of the degree. The DSC in such a case directs the candidate to ***modify the thesis as suggested within a given time not exceeding six months,*** and send the same (modified thesis) to the same examiner again for final report with respect to acceptance of modification made therein.

iv) Majority of the external examiners (***two or all***) reject the thesis.

8.6 **In the event of a thesis being rejected** by both the external examiners the Senate may on the recommendation of the DSC permit submission of a revised thesis on a additional payment of the prescribed fee, after a suitable time to be fixed by the Senate. The observations and comments of the examiners, if any may be copied and given to the candidate on request. In no case should the submission of the thesis without modification along the lines of criticism made by the earlier examiners be allowed. The revised thesis shall be refered again for assessment by the **external examiners (one or two)**. In case, the experts reject the revised thesis again, then the thesis will stand rejected.

8.7 Once the reports of the examiners have been accepted as satisfactory the candidate will have to defend his thesis before a viva voce board consisting of all DSC members and an Indian 'external' examiner (vide clause 12). In case the India 'external' examiner is not available to conduct the viva-voce, the Director at his discretion, may appoint another examiner either from the original panel of thesis examiners recommended by the DSC or advise that a faculty from an allied Department/ Centre of the Institute be appointed as the additional examiner to conduct the viva voce. In such cases the DSC shall recommend a faculty member of the Institute having knowledge in the area of the thesis topic to be appointed as the additional examiner.

If the viva voce board is not satisfied, the candidate has to appear again before within the next three months. The DSC shall recommend to the Senate the award of the Ph.D Degree if the viva voce is satisfactory and all other requirements have been fulfilled.

8.8 After the recommendations of the DSC either for acceptance of the thesis for the Ph. D. degree or for its rejection/ modification has been accepted by the Chairman, Senate or by the DSC/ DRC as the case may be, a copy of the reports of the examiners may be issued to the candidate at his request. However, the names of the examiners are not be disclosed.

8.9 Nothing contained in these Regulations shall preclude a candidate from publishing/ patenting either independently or jointly with the supervisor the results of the work incorporated in the thesis, at any time before or after submitting the thesis for examination.

9. AWARD OF THE DEGREE

A student who has completed satisfactorily all prescribed requirements and has cleared all fees and dues payable to the Institute and the Hall of Residence shall be eligible for the award of Ph.D. degree of the Institute by the Board of Governors on the recommendation of the Senate. The degree shall be awarded at the annual convocation for the academic session of the Institute.

10. FINANCIAL SUPPORT

Institute Research Assistantship will be available to eligible students as per MHRD, GOI norms. The period and amount of research assistantship shall be as per notification of the competent authority from time to time.

11. RULES OF CONDUCT:

Scholars admitted to the Ph.D. Programme under any of the categories shall conduct themselves within and outside the premises of the Institute in a manner befitting the scholars of an Institute of National importance. Detailed rules regarding conduct and discipline are given in Appendix – VIII.

In case residential accommodation is allocated to candidates, he/ she shall have to follow the rules of Hostel/ Hall of Residence.

12. LEAVE RULES

12.1 The record of leave and attendance shall be maintained by the department/ centre for each candidate and shall be made available to DSC/ DRC as and when required along with the candidate's annual progress report.

12.2 Leave of any kind may be subject to approval of the Head of the department/ Centre on recommendation of the Supervisor.

12.3 The Ph. D. candidates shall not be entitled to avail Semester break, summer and winter vacations.

12.4 A Research Scholar under any category may be permitted to be on leave from the Department/ Centre for a limited number of days per year of stay, as below.

i)	**For incidental purpose**	**CASUAL LEAVE**	**-**	**15 days**
ii)	**For treatment on illness**	**MEDICAL LEAVE**	**-**	**15 days**

The leave will be granted by the Head of the Department /Centre on the recommendation of the Supervisor and any leave not availed of in a year shall not accumulate.

12.5 **Married Research Scholar** admitted to the Research Programme of the Institute shall, in addition to **casual leave and medical leave prescribed by foregoing sub- para, be entitled to maternity/ paternity leave as per Govt. of India rules** if the request for the leave is supported by a medical certificate from a registered medical practitioner.

12.6 In case of extensive field work, data collection, library consultation, experimentation etc., absence from the Institute may be allowed up to a period of 12 weeks per year and be considered on duty on certificate of the Supervisor and approval of the Head of the Department/ centre.

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APPENDIX – I

COMPOSITION OF THE DEPARTMENTAL RESEARCH COMMITTEE[2]

Each department of the Institute shall constitute a Departmental Research Committee (DRC) with following members:

1.	Head of the Department	Chairman (ex–officio)
2.	Professor of the Department nominated by HOD	Members (Two)
3.	*Associate Professor* nominated by HOD	Members (Two)
4.	Concerned Supervisor(s) - for his/her candidate only	Member Invitee

i. *The members of DRC himself/ herself must be holding Doctoral level Degree/ qualification. However this may be relaxed in special case only if the faculty member of the department is having outstanding academic record of research/ publication in the relevant branch/ discipline*.

ii. *The department may consider nominating a Professor or Associate professor from other department or other Institution of repute (such as IITs, NITs, CFI etc.) as member of DRC provided he/ she has research experience and publication in the relevant branch/ discipline. All such members shall be entitled for sitting honorarium, TA/ DA as per Institute rules for attending meeting of the DRC.*

iii. *If any department do not have sufficient numbers of Professor or Associate Professors then Assistant Professor(s) of the department may also be considered for nomination as member of DRC with approval of the Director, provided he/ she is having Doctoral qualification and has research experience/ publication in the relevant branch/ discipline*.

Departmental Research Committee shall be responsible for following activities with respect to Ph.D Programme:

(i) To Identify the Areas of Research

(ii) To scrutinize the applications received for Ph. D Programme.

(iii) To conduct written test and interview for selection

(iv) Recommend name of the candidate(s) and supervisors for enrollment.

(v) To decide the course work for Ph. D. candidates to be offered by the department and its syllabus, evaluation methodology, credits etc..

(vi) Courses to be offered/ completed by the candidate in the other department(s) of the Institute or to be completed at other Institute/ university within India or outside India.

(vii) Evaluation of all courses undertaken by the candidate

(viii) Organize registration and thesis pre-submission seminar for the candidate within time-limit defined by the regulation.

(ix) Submission of progress report of all candidates enrolled/ registered for Ph. D. Programme.

2 Vide amendment approved in the 7th Senate meeting held on 12.06.2010

COMPOSITION OF THE DOCTORAL SCRUTINY COMMITTEE

The Head of the Department in consultation with the supervisor shall constitute a Doctoral Scrutiny Committee (DSC) for each candidate admitted to the Research Programme leading to Ph. D. degree.

It shall consist of the following members:

1.	Professor of the Department nominated by the Head of the department.	Chairman (ex–officio)
2.	Supervisor(s): for his/ her candidate only	Convener
3.	Three members of the Faculty to be nominated in consultation with the Supervisor(s)	Members

The DSC should be constituted within two weeks of candidate's joining.

Note: A member of the Faculty who himself is enrolled for the Ph.D. degree of the Institution or does not have adequate experience in the relevant field, shall not be appointed supervisor or a member of the Doctoral Scrutiny Committee for any other candidate enrolled for the Ph. D degree.

APPENDIX – II

ADMISSION PROCEDURE FOR Ph. D. PROGRAMME

(Weightage to be given for selection under section 3 of the Regulations)

1. Candidates possessing qualification as stated in 3.2 are to be selected for admission to the Programme on the following weightage.

		For Master's Degree	For Bachelor's Degree (In Engg./ Tech./ Architecture or equivalent)
(a)	Overall academic performance	70 percent	50 percent
	AND		
(b)	Test and Interview conducted by the Department / Centre	30 percent	50 percent

2. Details of the weightage/ marks for different components for (a) and (b) shall be prepared by Departmental Academic Committee/ Selection Committee and approved by the Director/ Chairman, Senate.

APPENDIX – III

SUMMARY OF TIME LIMITS FOR DIFFERENT ACTIVITIES related to Ph. D Programme

The summary of time limits for different activities as per the regulation for Ph. D. Programme under different sections and sub-sections have been detailed below for reference:

S. No.	***Scheduled Academic Activities***	***Full-time: Time limits***	***Part-time: Time limits***
1.	Provisional Enrolment to the Ph.D. Programme	Within one month of selection	Within one month of selection
2.	Course Work	Minimum: One Semester	Minimum: One years Maximum: Two Years
3.	Change of Category from Full-time to Part-time	After One Year	---
4.1	**Registration Seminar:** for acceptance of Research Proposal ***(from date of enrolment)***	Within One year	Within Two years
4.2	If Registration Seminar not Satisfactory, then Improved Research Proposal Seminar	Within next Three months of 1st Seminar	Within next Three months of 1st Seminar
5.	Registration for Ph. D. Degree	Within One month of approval of registration seminar	Within One month of approval of registration seminar
6.1	**Thesis Pre submission Seminar** before DRC	Minimum three Years from the date of enrollment, Please Ref Section 2, 5 and 6	Minimum three Years from the date of enrollment. please Ref Section 2, 5 and 6
6.2	Revised Thesis Pre submission Seminar	Within next six months of 1st Pre submission Seminar	Within next six months of 1st Pre submission Seminar
6.3	**Thesis Submission for final evaluation**	Within two months of approval of Pre Submission seminar	Within two months of approval of Pre Submission seminar
7.1	**Maximum time Limit for completion of Ph. D. Programme *from the date of enrolment.***	**Five years**	**Six years**
7.2	Extension of Registration beyond above maximum Time limits: ***on the recommendation of DSC and approved by the Senate.***	Additional One year	Additional One year

APPENDIX – IV

RULES FOR SPONSORED and SELF FINANCING CANDIDATES to Ph. D. PROGRAMME

1. The Institute may admit Self- supporting candidates and persons who are in gainful employment as '**Self Sponsored Scholars**' to the Ph. D. Programme subject to the following conditions.

2. Persons who possess the minimum prescribed qualifications as per clause 3.2 and are in service in any of the following establishment shall be eligible for admission to the Ph.D Programme as sponsored scholars.

   (i) Defence or other ministries of the Government of India or any other government organizations.

   (ii) Established industrial research and development organizations

   (iii) Autonomous bodies and public undertakings.

   (iv) Universities/ Autonomous institutions/ colleges

   (v) Such industries as may be recognized by the Senate of the Institute for the purpose from time to time.

   (vi) Self-financing candidates from Industry etc.

3. Qualified teachers of recognized Engineering College selected under the Quality Improvement Programme (QIP) of the Govt. of India and of **Science Colleges** who are awarded Teacher Fellowship of the University Grants Commission shall be eligible for admission to the Programme.

4. The Chairman of the Senate may, on the recommendation of the Department Research Committee (DRC), **relax the above norm to the extent deemed reasonable in the case of a self-sponsored candidate having long experience and/or additional professional qualification**.

5. An intending sponsored candidate must submit his application in prescribed form for admission through his employer who will forward the same to the Institute with suitable endorsement so as to reach the Institute by the date stipulated in the notification for the admission in that semester of the academic session.

6. A sponsored candidate selected for admission shall be required to be present in person at the time of joining the Institute.

6.1 To submit evidence of having passed the qualifying examination and such other documents as the Institute may require.

6.2 To produce certificate from the employer to the effect

   6.2.1. That the candidate has been officially released from his duties for the purpose of joining the Programme and has been granted the leave for the required period.

   6.2.2. That the services of the candidate shall be retained with the employers.

   6.2.3. The candidate shall produce a release certificate from his/her employer at the time of admission.

7. Sponsored research candidate shall not be eligible for any scholarship.

8. The sponsored candidates are required to complete the course work as per Clause 13 of the regulation.

9. The minimum residential requirement to complete the course work ***for a sponsored candidate as per clause 5*** shall be of ***one year or till he/ she completes the course work. Out of one year the candidate shall have to devote one semester at a stretch at NIT Patna immediately after enrolment. Rest of the duration may be spread over to another one year.***

10. A candidate sponsored by an industry, an R & D Organization, educational Institution or a Government Organization having adequate research facilities may be allowed to work externally subject to his fulfilling all such conditions prescribed for these works partially or entirely at the

Organization shall be granted only if the DRC is satisfied about availability of research facilities and fulfillment of the following requirements. Such permission is to be obtained in advance.

11. When a sponsored candidate has been allowed to work at parent Organization **with a joint supervisor from the sponsoring Organization** joint supervisor with adequate qualification and research experience may be appointed with the approval of DRC.

12. When a sponsored candidate has been allowed to work at his/ her parent Organization he/ she will be required to maintain frequent contact with the supervisor in the Institute.

13. No candidate shall normally be allowed to change the category under which he/ she is enrolled. However, if enrolled as self – supporting and the candidate obtains a national level scholarship/ fellowship this condition shall be waived off.

14. Subsequent to his/ her enrolment and wishes to change his/ her enrolment status he/she will have to cancel his/ her enrolment and take re-admission to the Ph. D. Programme as Institute Research Scholar/ Individual Research Fellow/ Scholar. The DRC shall however have the liberty to waive off the requirement for the course work he/ she has already completed and passed with status. The enrolment shall however remain valid for ***maximum period of six years from the date he/ she has been admitted to the Ph.D. Programme originally as self-supporting candidate***.

APPENDIX – V

RULES RELATING TO ENROLMENT OF MEMBERS OF TEACHING AND NON TEACHING STAFF

1. Members of teaching and non-teaching staff of the Institute may be permitted to join the Ph.D. Programme of the Institute **provided the prior permission has been obtained from the Director before applying for admission to the Programme**.

2. The application for permission to join a research Programme by a member of teaching/ non–teaching staff must be submitted through the Head of the Department/ Centre of the section in charge, as the case may be. While submitting the application he/ she must give an undertaking in the form appended hereto (Schedule –A).

3. The prescribed minimum qualifications and percentage of marks/ CGPA for admission to the Ph.D. Programme as given under clause 2 of the regulation shall be applicable to a member of staff of the Institute also. The Chairman of the Senate may, on the recommendation of the DRC, relax the above norm for the staff having long experience and/ or additional professional qualification.

4. All common rules laid down in the Ph.D. Regulations relating to course work, prosecution of research work under the supervision of a member of faculty, etc shall be applicable to all members of staff being enrolled for Ph. D. Programme.

5. All members of staff permitted to join research Programme must pay the prescribed enrolment – cum registration fee and also the thesis evaluation fee before submission of the thesis on completion of the work.

6. **A member of staff enrolled to the Ph.D. Programme <u>shall be exempted from payment of any tuition fee and other fee except the following</u>** which all Ph. D. candidates are required to pay

    a) Admission fee (Enrolment cum registration fee)

    b) Thesis Evaluation fee

7. Members of staff permitted and enrolled for the degree shall not be entitled to get any Scholarship.

8. Other conditions for permission to the categories of teaching and non-teaching staff for internal/ external registration to Ph. D. Programme shall be as follows:

A. **Internal Registration for Members of the Teaching Staff**:

(i) A faculty member enrolled for the Ph. D degree may depending upon his/her research experience carry out his/ her research work under the supervision **of Supervisor(s) of which one Supervisor must be a faculty** of the Institute. The Chairman of the DSC shall however be the chairman of the faculty member's own department/ centre DSC.

(ii) The Doctoral Scrutiny Committee constituted in respect of member of teaching staff applying for registration may recommend exemption/ relaxation from doing the necessary course work in view of the qualification he/ she possesses or his/ her teaching experience.

In case of **exemption/ relaxation for** teaching staff **from doing the necessary course work** as stated above, to evaluate the progress of the research work from Semester to Semester of the teaching staff given exemption from course work they will have to present **Seminar of L-T-P: 0-0-6, Credits: 4,** in each Semester and that will be **evaluated by a panel of examiners consisting of two experts nominated by HOD and the Supervisor(s)** [3]

(iii) A member of a faculty who has put in at least 2 years of continuous service in the Institute may on the recommendation of the Doctoral Scrutiny Committee, be **permitted to submit his thesis on completion of minimum period of two years from the date of registration seminar, he/ she will however be required to go through the formalities of course work (if necessary) and seminars before submission of the thesis**.

B. **Internal Registration for Members of Non-Teaching Staff:**

(i) A member of non-teaching staff seeking permission to join the research Programme should hold a permanent post in the Institute. Scientific Officers of the Institute who have been appointed on contract basis for minimum period of five years are also eligible to enroll under this clause.

(ii) The administrative permission to join a research Programme by a member of non–teaching staff can be withdrawn by the Institute at any time under these rules, due to the exigencies of Institute work.

(iii) Every application for permission under rules shall be examined by the Departmental Research Committee taking into account whether the proposal for joining the Programme for which permission is sought for arises out of genuine interest and ability of the candidate.

(iv) After the permission is granted he/she will submit his/ her application on prescribed form together with the prescribed enrolment cum registration fee on receipt of this application the Head of the Department/ Centre concerned will place the same before DRC for composition of the Doctoral Scrutiny Committee.

(v) The minimum period to be spent in the research work by a member of non–teaching staff registered for the Ph. D. degree shall be three years. The **maximum period admissible for completion of the work and submission of the thesis shall however remain** the same as in the case of part-time candidates.

C. **External Registration for Members of Teaching and Non-teaching Staff:**

(i) A member of teaching staff may get registered under QIP scheme, and then approval for such request shall be governed by the rules under the QIP Scheme of MHRD/ AICTE.

(ii) A member of Teaching or non-teaching staff of the Institute and desirous to get registered himself/ herself for Ph. D Programme outside the Institute (other than QIP Scheme) shall be permitted if he/ she has requested for grant of permission

a. To carry out research work at Central Universities/ Central Institutes/ Institutes of Repute such as IISc, IITs, IIMs, NITs, IIITs, NITIE etc..

3 Vide amendment vide notification No. 203/2011 dated 21-11-2011 approved in the 9th Senate meeting held on 17.09.2011 to be applicable to all NIT Faculties registered and granted exemption from course work.

b. The applicant must have completed two years of service after his/ her confirmation on the substantive post at the Institute. However, nature of leave and leave salary etc applicable to him/ her shall be as per the service rules of the Institute.

SCHEDULE – A UNDERTAKING

I Mr./Ms. …….member of the teaching/ non-teaching staff holding a permanent post of ……..……in the Department/ Centre of …… at the National Institute of Technology Patna, hereby give the undertaking that I shall abide by the rules and regulations as may be laid down by the Senate of the Institute from time to time for undergoing the Ph.D. Programme

I also undertake hereby that since I shall be on duty while undergoing the Programme of studies/research I shall ensure that all normal official duties assigned to me are executed without any handicap.

I further understand that the permission granted to me for joining the Programme can be withdrawn at any time if the exigencies of official duties so require or if I breach any of the provisions of rules and regulations.

Date: …….. (Signature of the Candidate with name)

APPENDIX –VI

TERMS AND CONDITIONS FOR AWARD OF INSTITUTE RESEARCH ASSISTANTSHIP

1.1 All Research Scholars admitted to the research Programme ***except the sponsored scholars, self-supporting candidates and members of staff of the Institute*** shall be entitled to get the award of Institute Research Assistance as per to the terms and conditions laid in clause 4 of the regulation.

1.2 A person employed in the Institute temporarily under a project or scheme or who enjoys an outside Scholarship other than QIP/ TF, and who has been registered for the Ph.D. degree may be granted, on the recommendation of the DSC and DRC. Institute Research Assistance shall be given subject to fulfillment of the conditions of the rules. However, the total period of the scheme service enjoyed and the Institute Research Assistance taken together should **not exceed four years**.

1.3 If due to any reason Institute Research Assistance is discontinued, then it will not be continued again. However, such candidates may continue their research work as self-financing candidate.

1.4 Transfer from CSIR/ UGC etc. individual fellowships and from research projects to Institute will be guided by the following.

i) One must have completed at least twenty years in a research project/scheme.

ii) Individual research scholars from external funding agencies like CSIR/ UGC/ ICAR etc. must have completed 3 years as Individual fellows.

iii) The candidates will present their work done so far his/ her Ph.D. at an open Seminar with the DSC and DRC present and the DRC will satisfy itself that the case is deserving.

iv) The candidate must be GATE/NET fellowship qualified.

v) Such a case can be considered only if the fellow has been registered for the Ph.D.

vi) All other rules applicable for selection of regular Institute scholars would apply.

2. **General**

2.1 No Research Scholar shall be permitted to accept or hold any appointment, paid or otherwise or receive any emoluments, salary, stipend or any other Scholarship during the tenure of award. In the event of a scholar being awarded another Scholarship of the Institute or of any external organization/ Institution he/she will have the option to retain any one of the awards according to his/ her choice which he/she will communicate immediately in writing to the Dean (Acad.).

2.2 QIP scholars shall however draw fellowship and contingency grant from QIP Programme of MHRD only as per rules applicable to them. They shall in no case be eligible for award of **Institute Research Scholarship.**

2.3 **Research Scholars** may be assigned **academic responsibilities up to six hours per week tutorial classes, laboratory/ demonstration work**, conduct of Seminar/ Symposia running and maintenance of equipment/ computer as may be decided by the Head of the Department/ Centre in consultation with the Supervisor(s).

2.4 A Research Scholar shall maintain, besides satisfactory academic progress, good conduct behavior and discipline of the Institute. In the event of a scholar being found to be involved in any act of misconduct, misbehavior, indiscipline or use of unfair means at an examination, the financial assistance is liable to be suspended with immediate effect.

2.5 If a Research Scholar wishes to relinquish the fellowship during the tenure, it should be done with the prior approval of the Supervisor, the Head of the Department/ Centre and the Dean (Academic). He/ she should also obtain prior permission from the same authority for appearing at any examination conducted by any Institution, University or Public Body.

3. Value of Financial Assistance:

3.1 The value of the Institute Research Assistance shall be as per MHRD norms.

3.2 The Value of Research Scholarship of a registered candidate may be recommended for enhancement by the DSC after completion of two years of continuous research work on the basis of written report and a seminar lecture given in open with members of D.R.C present.

3.3 In the event of the DSC being not satisfied with the progress of a Scholar during the preceding two years it may recommend suspension of enhancement in the value of the Assistance for such period, as it deems appropriate. The Committee will re-assess the candidate's work after the period so fixed and if enhancement is recommended, the date from which the enhanced value will be effective shall be decided by DSC.

3.4 Contingency Grant shall be as per MHRD guidelines.

4. Tenure:

4.1 The financial assistance shall be payable from the date the scholar joins the Institute. At the initial stage the order for payment of Scholarship shall however, be issued when the scholar is enrolled formally.

4.2 The tenure of a research Assistance shall be four years counted from the date of joining, the initial award shall however, be released for one year and then renewed from year to year up to third year, subject to satisfactory progress.

4.3 On the recommendation of the DSC the tenure may be extended for a further period of one year, granting the extension for not more than six months at a time subject to the Scholar's satisfactory performance at seminar lecture delivered to an open audience embodying the progress of the work during the last six months. Grant of a six monthly installment of the tenure shall be subject to actual requirement of the Scholar's work to the certified by the DSC after assessing the progress of the work presented through a written report and seminar lecture.

4.4 Normally the tenure of the financial assistance awarded to a scholar will terminate with effect from the day following the date of submission of thesis provided he/ she has not left the Institute earlier and has been working in the Department/ Centre till that date. However, a scholar may be allowed to draw Scholarship for further period of 3 months to complete any unfinished part of experiment undertaken relating to his/ her research work, subject to the overall limit of 4 years,

on the recommendation of the supervisor. The scholar has to be full time student during this period.

4.5 The financial assistance for the last month shall be payable subject to foregoing conditions up to the actual date of the scholar's presence in the Institute. The disbursement of last monthly installment of financial assistance shall be made on production of a 'No Dues' certificate from the Hall of Residence, the Library and the Department/ Centre and the Academic Section of the Institute.

4.6 Notwithstanding anything contained in the foregoing sub paragraphs, continuation of Scholarship from month to month is subject to candidate's good conduct and continuous progress of research work to the satisfaction of the Supervisors(s), the Head of the Department/ Centre and other authorities.

5. Leave rules:

5.1 An Institute Research Scholar is required to carry out his/ her research work regularly under the guidance of the Supervisor(s) without any interruption during the period he enjoys the financial assistance.

5.2 A scholar shall be entitled to (i) **casual leave of 15 days** and (ii) **medical leave of 15 days** of **in a year counting from the date of joining the Programme**. Any leave not availed of shall not accumulate.

5.3 **Married Research Scholar** admitted to the Research Programme of the Institute shall, in addition to **casual leave and medical leave prescribed by foregoing sub- para, be entitled to maternity/ paternity leave as per Govt. of India rules** if the request for the leave is supported by a medical certificate from a registered medical practitioner.

5.4 Any absence over and above the admissible leave as prescribed above shall be without financial assistance which shall be deducted on pro rata basis for the days of such absence.

5.5 A research scholar may on the recommendation of the Supervisor and the Head of the Department/ Centre be granted **leave without financial assistance for a total period not more than three months**, during the entire tenure of Scholarship by the Dean (Academic).

5.6 In exceptional circumstances the Dean (Academics) may on the recommendation of the DSC grant a Research Scholar **leave without financial assistance for period not exceeding 12 months in the entire period of his tenure for purpose** of accepting teaching/ research assignment on temporary basis provided the post accepted by research scholar is in the same department or in an educational institution, R & D organization or an industry of repute. When a scholar granted such leave without Scholarship the enhancement of the value of Scholarship shall be deferred for the appropriate period. In all cases of leave granted under the para 4 above, period spent on leave shall be counted for the purpose of termination of the tenure of the Scholarship.

SCHEDULE – B LEAVE, CONTINGENCY EXPENSES & OTHER ADMINISTRATIVE MATTERS OF RESEARCH SCHOLARS OF DIFFERENT CATEGORIES

A) LEAVE

i) **Institute Research Scholars :**

Research Scholars can avail of the following types of leave in a year from the date of joining:

CASUAL LEAVE:	**15 days**
MEDICAL LEAVE:	**15 days**

In case of serious illness, the research scholar may avail a part of casual leave as medical leave, in addition to 15 days, at the discretion of the H.O.D/ H.O.C. They are not entitled to avail vacation leave (summer & winter). Any leave not availed of shall not accumulate. Married research scholars would be eligible for the maternity/ paternity leave as per Govt. of India norms. Such leave will be granted only once during the period of tenure of the award.

In cases where extensive field work is necessary, absence from station up to a period of 12 weeks per year be considered as on duty on certification of the Supervisor/ Head of the Department/ Centre.

ii) Other **categories (scheme research fellows/ CSIR/ self – supporting etc.):** Same as that of applicable for Institute Research Scholars.

B) MODE OF THE CONTINGENCY EXPENSES

1. Purchase of stationery/ Xeroxing/ Typing/ Printing shall be as per MHRD norms
2. Visit to other places :
   (a) for attending Conference/ Seminar –
      (i) Permission to attend conference/ seminar will be granted once a year
      (ii) Registration fee shall be reimbursable up to the value fixed by the Institute from time to time
   (b) for field work, data collection or approved similar purposes :

      Admissible duration (for the purpose or TA/DA) shall be 21 days in a year , 7 days at a time.

C) HOUSE RENT ALLOWANCE/ DEARNESS ALLOWANCE

i) ***Institute Research scholars:*** There will be no House Rent Allowance, Dearness Allowance.

ii) ***Other Categories*** (scheme research fellows/ CSIR etc.): Same principle will be applicable.

D) TERMINATION OF ENROLMENT

i) **Institute Research Scholars/ Self supporting** etc.

On the basis of reports received from Doctoral Scrutiny Committee, the enrolment may be terminated at any time for reasons of unsatisfactory performance and the Institute's decision in this regard shall be final.

ii) ***Other categories (scheme/ research fellows/ CSIR)* :** Same as above

E) OTHER ASSIGNMENTS

I) Institute Research Scholars :

No one shall accept or hold any appointment, paid or otherwise or receive any emoluments, salary, stipend etc. from any other source during the tenure of the award. However, they may receive honorarium against specific work done for projects (mainly consultancy) from time to time with the prior permission of the Supervisors (s) and Dean (Acad.)

ii) Other categories (scheme research fellows/ CSIR/ self – supporting etc.): same principle will be applicable.

F) RELINQUISHMENT OF RESEARCH FELLOWSHIP, PERMISSIONS

I) Institute Research Scholar :

If research fellow wishes to relinquish fellowship during the tenure, then it should be done with the prior approval of the Institute. He should also obtain prior permission of the Institute for appearing at any examination conducted by any Institution, University or Public Body.

ii) Other **categories (scheme research fellows/ CSIR/ self supporting etc.):** Same principle will be applicable.

APPENDIX –VII

RULES REGARDING CONDUCT AND DISCIPLINE

Following rules shall be applicable to all students and research scholars in the matters of conduct and discipline.

1. Research Scholars shall show due respect to the teachers of the institute, the wardens of the Halls of Residence, the Sports officer of the Gymkhana and the Officers of the National Cadet Crops, Proper courtesy and consideration should be extended to the employees of the Institute and of the Halls of Residence. They shall also pay due attention and courtesy to visitors.
2. Research Scholars are required to develop a friendly camaraderie with fellow students. In particular they are expected to show kindness and consideration to the new students admitted to the Institute every year, ragging of newcomers in any form is banned by law. The acts of ragging will be considered as gross indiscipline and will be severely dealt with.
3. The following acts omission and/ or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:
    - ❖ Ragging
    - ❖ Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus
    - ❖ Willful damage or stealthy removal of any property/ belongings of the Institute/Hall or of students
    - ❖ Possession, consumption or disruption of alcoholic drinks or any kind of hallucinogenic drug
    - ❖ Adoption of unfair means in the examinations
    - ❖ Mutilation or unauthorized possession of library books
    - ❖ Noisy and unseemly behavior, disturbing studies of fellow students

    Commensurate with the gravity of the offence, the punishment may be **reprimand**, fine expulsion from the Hall, debarment from an examination, rustication for specified period or even outright expulsion from the Institute.
4. For offence committed in (a) Hall of Residence, (b) the Department or in a class room and (c) elsewhere, the Chairman (HMC)/ Warden, the Head of the Department and the Dean of Students Affairs respectively, shall have the authority to **reprimand** or impose fine or take other suitable measures.
5. All cases involving punishment other than reprimand shall be reported to the Chairman of the Standing **Conduct and Disciplinary Committee of the Institute**.

APPENDIX –VIII

FEES AND OTHER CHARGES PAYABLE BY RESEARCH SCHOLARS

1. As prescribed by the Institute/ Statute, the following fees are payable by a Research Scholar annually at rates as in force for the time being, namely
    - a) Tuition Fees
    - b) Seat Rent for the accommodation in a Hall of Residence
    - c) Gymkhana Fees
2. If a Research Scholar is permitted to stay outside the Hall of Residence but within the campus of the Institute or at a close proximity to it, the Scholar will be attached to a Hall of Residence and will have to pay the seat rent at the prescribed rate together with such ‘establishment charges’ as may be levied by the Warden of the Hall concerned.

Note: Para 2 above of the Appendix shall be applicable only when the Institute becomes fully residential.

3. Every Research Scholar shall be required to pay at the time of joining the following items of fees at rates as in force for the time being:

    a) Refundable

        i) Institution Caution Money

        ii) Hostel Caution Money

        iii) Mess Deposit

        iv) Mess Advance

        v) Library Caution Money

    b) Non –refundable

        i) Admission

        ii) Tuition

        iii) Hostel Seat Rent & Water Charges

        iv) Gymkhana, Medical etc.

        v) Course work evaluation Fee and

        vi) Thesis Evaluation Fee (Payable at the time of submission of thesis)

    N.B. The fees at item Nos. (ii) (iii) and (iv) of (a) above are payable recurrently and are to be paid in the manner as directed by separate notifications

4. For the purpose of tuition fees and seat rent the year shall be counted from the date of joining of the Research Scholar except that the fees shall be charged from the first day of the month irrespective of the actual date of joining. Similarly at the time of leaving the Institution the tuition fees and seat rent shall be charged for the full month irrespective of the actual date of leaving.

5. Research Scholars under all categories except internal staff shall pay tuition fee and seat rent ordinarily for the entire duration of their research work till the date of submission of the thesis. Partial exemption may however, be allowed in the following cases.

    (a) A Research Scholar who has been granted permission to carry out research work at his parent Organization under the provisions of clause 3.1.4 the Regulations –

        i) Shall pay tuition fees for the minimum period of 2 or 3 years as the case may be prescribed by the Senate to qualify submission of the thesis under the provisions of the Regulation.

        ii) Will not be required to pay any seat rent after he leaves the Institution with Prior permission. However, if he/ she rejoin the Programme for completing the unfinished part of his work he/ she shall have to pay the seat rent for period of such subsequent stay. For calculation of the seat rent whole month will be counted as indicated in Para 4 above.

    (b) A Research Scholar who has been given under special consideration separate accommodation on rent in one of the premises of the Institute other than in a Hall of Residence for Research Scholars, then he/ she shall be required to pay only rent for the accommodation actually occupied by him.

APPENDIX – IX

GUIDELINES FOR APPOINTMENT OF SUPERVISOR/ JOINT SUPERVISOR/ CARETAKER SUPERVISOR

1. All candidates for the Ph.D. degree are required to carry out his/ her research work under the guidance of ***a supervisor from the Institute*** unless otherwise permitted by the Senate. However for certain candidates DRC may propose **more than one *supervisor drawn from the Institute and/ or from Industry/ R&D Organization as Joint supervisors***.

2. The **Departmental Research Committee (DRC)** may permit a research scholar with exceptionally good academic background and research ability, to carry out work for the Ph. D. degree independently without any supervisor. The modalities for granting such permission e.g. need "***appointment of a caretaker supervisor***" etc. will be formulated by the DRC on case to case basis.

3. When a research scholar is permitted by the DRC he may carry out a substantial part of the research work in an industry or in an organization with adequate R & D facilities, appointment of ***a joint supervisor from industry/ organization*** may be allowed provided that such permission shall not violate the condition for continuity of research scholarship of an Institute Research Scholar. The qualification of the Joint Supervisor from the industry/ organization shall have to be approved by the DRC.

4. For cases where the supervisor has guided the candidate for two years or more:

   (i) If the person proceeds on long leave for more than a year a joint supervisor should be appointed and if the leave is for less than a year a caretaker supervisor is to be appointed by the DRC. However, on the recommendation of the DSC a supervisor can be allowed to continue as sole supervisor on case to case basis depending on the state of progress of the thesis work.

   (ii) A person superannuating will continue to the sole guide, if the thesis is submitted within six months of the superannuation.

   (iii) If the thesis is not ready for submission within six months a joint supervisor must be appointed by the DSC

5. For a case where guidance has been given for less than two years :

   (i) when person proceeds on leave for mote than 6 months, a joint supervisor be appointed and in case the period of leave is less than 6 months a care –taker supervisor be appointed by the DSC However, if the leave is for 2 years or more the person shall cease to be a supervisor.

   (ii) A person superannuating shall continue as the Supervisor if the thesis is submitted within 6 months time otherwise another person will have to be appointed as the sole guide in his/ her place.

6. After superannuation from the service of this Institute, if a person joins the Institute as an Emeritus Scientist or in any other capacity, he may continue to be sole supervisor or a joint supervisor provided DSC recommends.

   Note: A person – re employed after superannuation shall continue to hold the same status in the matter till the end of the period of re – employment.

7. A faculty of the Institute having less than or equal to one year to superannuate (from the end of the academic session in the month of June of the year), can be appointed as thesis supervisor either singly or jointly with another faculty of the Institute.

8. Persons from outside the Institute, joining as Emeritus Scientists, Chair Professors and have more than two years service left, can be appointed as Supervisor for new scholars only with a regular teacher and not alone.

   Note: The above points are guidelines. Based on recommendation of DSC a candidate will be given due consideration in making decision in a particular case.

APPENDIX – X

THESIS SUBMISSION for EVALUATION: FORMAT GUIDELINES

Arrangement of Certificates and Texts in Thesis

1. Cover Page (Light Blue color and proper format)
2. Inside Cover Page (Identical to Cover Page)
3. Certification
4. Declaration & copy right
5. Acknowledgments
6. Synopsis
7. List of Tables and Figures
8. List of abbreviations (if any)
9. Contents

CERTIFICATE from the SUPERVISOR(s)

This is to certify that Mr./ Ms/ …….. …….. …… Roll No. …… …… Enrolment No. …….. …….. is a registered student for Ph. D. Program under department of ……. ……. ……. ……. of National Institute of Technology Patna.

The undersigned certify that he/ she has completed all other requirements for submission of the thesis and hereby recommend for the acceptance of a thesis entitled, '…… …… …… …….. …… …….. ' in the partial fulfillment of the requirements for the award of Ph. D. Degree by National Institute of Technology Patna.

……..

Dated ……. Supervisor(s) name, designation with signature and seal

DECLARATION AND COPYRIGHT

(to be signed by the student)

I …….. Roll No. …… …. … Enrolment No. …….. a registered student for Ph. D. Program under department of ……. ……. ……. ……. of National Institute of Technology Patna, declare that this is my own original work and that it has not been presented and will not be presented to any other University/ Institute for a similar or any other Degree award.

Signature of the student: ……..

Date: ……..

Student's Thesis Presentation Information for Ph. D

1. Contents of the thesis

CHAPTER ZERO Title, Certification, Declaration and copyright, Acknowledgment, Dedication, Abstract, Table of Content, List of Figures, List of Tables, Abbreviations

CHAPTER ONE Introduction & Background

CHAPTER TWO Literature Review

CHAPTER …
CHAPTER …
CHAPTER …
CHAP…..
CHAP …..

Chapter - 3 onward Chapter's Title, Heading, and contents etc. may be as per the Area of Research work and topics of discussion/ finding/ analysis etc.

CHAPTER … Summary, Conclusion and Recommendation for future Work

REFERENCE Use strictly the following reference writing method.

S. No, Surname, Initials (year) Title of the Journal or book. Vol.- 1 Pages e.g., *Country*

If the Author is only one

1. Atkinson, J.H. (1990) Examination of erosion resistance of clays in embankment dams. Quarterly Journal of Engineering Geology, Vol-23, page103-108, ***Country***

If the Authors are two

2. Atkinson, J.H. and Charles, J.A. (1990) Examination of erosion resistance of clays in embankment dams. Quarterly Journal of Engineering Geology, Vol-23, 103-108, ***Country***

If the Authors are more than two

3. Atkinson, J.H. and Charles, J.A. and H. K. (1990) Examination of erosion resistance of clays in embankment dams. Quarterly Journal of Engineering Geology, Vol-23, page 103-108, ***Country***

For books

4. Atkinson, J.H. and Charles, J.A. (1990) Examination of erosion resistance of clays in embankment dams. McGraw Hill, London

APPENDICES Summary data, intermediate results and other important information may be put under Appendices.

2. Font and Spacing

Title: Bold, Arial, 14 size and Centered
Subtitles: Bold, Arial, 12 size and left justified
Spacing: Spacing between text lines: 1.5, Arial, 12 sizes,
Leave one space between paragraphs, subtitle and the text or between Title and sub title.

3. Paper Margins

Left margin	:	4.0 cm
Right margin	:	2.5 cm
Top margin	:	4.0 cm
Bottom margin	:	2.5 cm

4. Printing

The entire thesis shall be printed only on one side of the paper.

5. Draft Submission

Five to six loose bound copies each for the examination committee shall be submitted on the set deadline.
One each for the HOD, the External and Internal Examiners, and each Supervisor(s).

6. Final submission

- Five original copies in case of one supervisor and six in case of more than one supervisor(s) of the thesis both in soft and hard copy (Hand bound in sky colour i.e. light blue Colour)
- All data used in the study (the raw and processed) shall be submitted in soft copy and in its original form
    i. Time Series data such as rainfall, river flow etc.
    ii. Spatial data such as topographic data, soils and land use (if any)
    iii. The following format may be used to store the softcopy information in a CD.

E:/ Thesis E:/ Data/ Time Series/ Raw E:/ Data/ Time Series/ Processed E:/ Data/ Spatial/ Raw Data E:/ Data/ Spatial/ Processed Data E:/ Programmes (if any Programme is written)

1

Detailed of Course work offered to Doctoral Program Research Students

A candidate shall eligible for registration to Ph. D Program only after completion of Course work of 16 credits to be completed in first two semesters. A student is required to complete the courses as decided by DSC under Para 5 of the regulation.

S. No.	Prog Code	Course Code	Course Title	L	T	P	Credits
			Architecture				
1	ARPH	AR 7x01	Research Methodology	4	0	0	4
2	ARPH	AR 7x02	Intelligent Building Systems and Design	4	0	0	4
3	ARPH	AR 7x03	Energy, Technology and Habitats	4	0	0	4
4	ARPH	AR 7x04	Seminar	0	0	6	4
5	ARPH	AR 7x95	Research Seminar	0	0	6	4
			Civil Engineering				
1	CEPH	CE 7x01	System Analysis and Optimization Techniques (CE 2101)	4	0	0	4
2	CEPH	CE 7x02	Construction Technology (CE 2102)	4	0	0	4
3	CEPH	CE 7x34	Concrete Technology (CE 2234)	4	0	0	4
3	CEPH	CE 7x03	Fundamentals of Earthquake Engineering	4	0	0	4
4	CEPH	CE 7x04	Laboratory Works in Earthquake Engineering	0	0	6	4
5	CEPH	MA 7x06	Advance Numerical Methods and Computational Techniques (MA 2106)	4	0	0	4
6	CEPH	CE 7x71	Wastewater Flow and Quality Management	4	0	0	4
7	CEPH	CE 7x72	Physico-Chemical Processes for Wastewater Treatment	4	0	0	4
8	CEPH	CE 7x73	Biological Processes for Wastewater Treatment	4	0	0	4
9	CEPH	CE 7x95	Research Seminar	0	0	6	4
			Chemistry				
1	CHPH	CH 7101	Molecular Symmetry	3	0	0	3
2	CHPH	CH 7102	Spectroscopy	3	0	0	3
3	CHPH	CH 7103	Aspects of Organic Chemistry	3	0	0	3
4	CHPH	CH 7104	Hetrocyclics Compounds and Macromolecules	3	0	0	3
5	CHPH	CH 7x05	Bonding in Coordination and Organometallic Compounds	3	0	0	3
6	CHPH	CH 7x07	Stereochemistry	3	0	0	3
7	CHPH	CH 7x08	Chemistry of Natural Products	3	0	0	3
8	CHPH	CH 7x09	Inorganic and Organic Polymers in Metal Clusters Compounds	3	0	0	3
9	CHPH	CH 7x10	Quantum Chemistry	3	0	0	3
10	CHPH	CH 7x11	Organic Photochemistry and Pericyclic Reactions	3	0	0	3
11	CHPH	CH 7x06	Technique in Organic Synthesis and Characterization	0	0	3	2
12	CHPH	CH 7x12	Water and Soil Analysis	0	0	3	2
13	CHPH	CH 7x13	Estimation and Separation Techniques of Anions and Cations	0	0	3	2
14	CHPH	CH 7x14	Physical Process in Reactions	0	0	3	2
15	CHPH	CH 7x15	Chromatographic Separations Techniques	0	0	3	2
16	CHPH	CH 7x16	Separation and Extraction of Organic Molecules	0	0	3	2
17	CHPH	CH 7x17	Complexes and Their Preparation	0	0	3	2
			Computer Science & Engineering				
1	CSPH	CS 7522	Genetic Algorithms (CS 2x22)	3	1	0	4
2	CSPH	CS 7x95	Research Seminar	0	0	6	4
			Humanities & Social Sciences				
1	HSPH	HS 7101	English Paper - 1	4	0	0	4
2	HSPH	HS 7102	English Paper - 2	4	0	0	4
3	HSPH	HS 7203	English Paper - 3	4	0	0	4

S. No.	Prog Code	Course Code	Course Title	L	T	P	Credits
4	HSPH	HS 7204	English Paper - 4	4	0	0	4
5	HSPH	HS 7111	Economics Paper - 1: Research Methodology	4	0	0	4
6	HSPH	HS 7213	Economics Paper - 2: Advanced Microeconomics	4	0	0	4
7	HSPH	HS 7112	Economics Paper - 3: Advanced Microeconomics	4	0	0	4
8	HSPH	HS 7214	Economics Paper - 4: Indian Rural Development	4	0	0	4
			Electrical Engineering				
1	EEPH	EE 7570	Neural Networks and Applications (EE 2x70)	3	0	3	5
3	EEPH	CS 7522	Genetic Algorithms (CS 2x22)	3	1	0	4
2	EEPH	EE 7x95	Research Seminar	0	0	6	4
			Electronics & Communication Engineering				
1	ECPH	EC 7x95	Research Seminar	0	0	6	4
			Mechanical Engineering				
1	MEPH	ME 7x01	Research Methodology	4	0	0	4
2	MEPH	ME 7x02	Experimental Methods	4	0	0	4
3	MEPH	ME 7x03	Mechanical Engineering Lab	0	0	6	4
4	MEPH	ME 7x04	Computational Fluid Dynamics	4	0	0	4
5	MEPH	ME 7x62	Advanced Thermodynamics (ME 2x62)	4	0	0	4
6	MEPH	ME 7x95	Research Seminar	0	0	6	4

DEPARTMENT OF ARCHITECTURE

AR 7101 Research Methodology

Credits: 4 L-T-P: 4-0-0

Objective- To introduce the research methodologies to researchers. This has been given more credit so that the student learns the methods and follows the same while carrying out his work.

1. **Fundamentals of Research: Research: Meaning, Concept and Need; Historical Research; Survey Research; Experimental Research; Fundamental, Applied and Action research**
2. **Tools of Research- Measurement of Variables; Data Presentation; Statistical Techniques; Statistical Packages**
3. **Research Methods: Observation Method; Questionnaire Method; Interview Method; Experimental Method; Case Study**
4. **Research Process: Research Design; Research Plan; Statistical Inference; Presentation of Results**
5. **Research documentation**

AR 7x02 Intelligent Building Systems and Design

Credits: 4 L-T-P: 4-0-0

Objective: To introduce intelligent building systems for efficiency and management

1. **Introduction to Intelligent Buildings**
2. **Building Envelopes, Intelligent Façades, Living Roofs Glazed cladding prototypes, Day Lighting, Weathering, Water Smart Learning Environments: Operations and Optimizations, Search for Efficiency Intelligent Building Management Systems, Personalized environments and controls Examples: Building Information Management,**
3. **Introduction to Energy Efficient HVAC systems, Plumbing Design, Lighting, Mechanical and Electrical Utilities. Operations and Maintenance of Buildings for energy efficiency**
4. **Security systems for personal safety Like Earthquake, fire , Explosion etc**
5. **Building Management Systems**
6. **Assignments – case studies of designed intelligent buildings**

AR 7x03 Energy, Technology and Habitats

Credits: 4 L-T-P: 4-0-0

Objective: introduction to energy and environmental issues, basic principles of energy generation and energy use and the fundamental climatic precursors and patterns. The technological response to interior environmental control within the larger framework of the scientific and socio-cultural influences that shaped the building systems.

1. **Design with Nature; Climate, Micro-Climate, Site, Environmental Impact Assessment.**
2. **Sustainability: Green Design, Life Cycle Analysis, Zero Energy, Carbon Neutral, Regenerative Design, Healthy Environments**
3. **Climatic Control System in Tropical Countries**
4. **Design for Performance Optimization: Climatically Responsive Designs, Passive solar considerations, shading and cooling, natural ventilation,**
5. **Integrated Passive and Active Environmental Systems, Renewable Energies & Demands.**
6. **Introduction to Energy Conservation Building Codes and Energy Audits and related acts.**
7. **Assignment: Design integration and consideration for application of non-renewable energy in Habitats.**

AR 7x04 Seminar

Credits: 4 L-T-P: 0-0-6

Based on case studies and literature study of designed green structure over the world.

AR 7x95 Research Seminar

Credits: 4 L-T-P: 0-0-6

Candidate should have to give at least two seminar on the topic related to his research work. The final / end semester evaluation shall be done by a panel of examiners consisting of two experts nominated by HOD and the Supervisor(s)

DEPARTMENT OF CHEMISTRY

CH 7x01 MOLECULAR SYMMETRY

Symmetry elements, symmetry operations, Evaluation of symmetry point groups, properties of groups, Determination of symmetry point group of BF_3, H_2O_2, $B(OH)_3$, trans-and cis $(NH_3)_2Cl_2$, p-,o- and m-dihydroxy and dihalobenzene, anthraquinone, PF_6, SF_4 and common molecules. Formation of symmetry group, Group multiplication table. Matrix representation of symmetry element. Types of matrices, Transpose, inverse matrix and raciprocal matrix. Symmetry point group and structure, Operations in symmetry element using matrices and symmetry representation.

Definition of group, characteristics of groups, Linear transformation of coordinates, Cartizen coordinate to polar coordinates, matrix representation of symmetry operations, Group, Sub-group, Symmetry class, Orthogonality theorem, Reducible and irreducible representation and constraction of character table of C_{2V}, C_{3V}, D_{4h} and O_h symmetry point group. Splitting terms in cubic symmetry, Sign formula, Application of character table in studies of I.R and U.V.spectra.

CH 7x02 SPECTROSCOPY

Electronic absorion spectrophotometric methods, Woodward rule of electronic absorion spectrum, Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Electronic transition, Origin of colour, Charge transfer transitions effect of solvents and pH on electronic transitions, assignment of electronic transitions in organic and complex molecules, Infrared spectral method for ascertaining functional group, group frequency, Affect of H-bonding, Intensity and origin of I.R bands, Fundamental mode of I.R vibrations, Overtone and combination bands, Application of I.R spectroscopy in structure determination, Normal coordinate analysis.

EPR spectroscopy: - Application for predicting reaction mechanism and free radical reaction.

NMR spectroscopy: - Basic theory of nuclear magnetic resonance (NMR) spectroscopy, Chemical shift, Spin-spin coupling, Coupling constant, Contact shift, spin-spin interaction and NMR signals, Equivalent and non-equivalent proton, NMR peak area, Integration curve, TMS, j-j coupling, Carbon- C^{13} NMR, Proton coupled and protone decoupled C.M.R spectra, C.M.R chemical shift, Proton exchange, ^{19}F NMR spectra, Basic conce of ^{31}P spectra, Assignment of structure of organic and coordinated complexes containing organic donor molecules from NMR and C^{13} NMR data.

Mass spectroscopy: - Theory and type of mass spectroscopy, Mc-Lafferty rearrangement, Base peak, Fragmentation pattern, Mass spectrum and structure of organic molecules.

Basic conce of Vibrational, Rotational, Mossbauer, Photoelectron, Fluroscence, Flamephotometry, XRD and Thermogravimetric technique for determination of structure and constitution of molecules.

CH 7x03 ASPECT OF ORGANIC CHEMISTRY

Methods of C—C bond formation, Organic molecules containing different functional groups, Properties of different functional groups, Formation of alkene and alkyne, Substitution, Addition, Elimination reaction, Nucleophilic and electrophilic reactions in alkenes, alkynes and

cycloalkenes, Trends in melting point of hydrocarbon, Hydrogen bonding, Free radical reactions, Mechanism of S_N1, S_N2, E_2, E_1 and free radical reactions.

Aromaticity, Huckel rules, Substitution reactions in aromatic system, Effect of substituant groups in benzene and aromatic compounds, Determination of orientation in benzene, Relative reactivity of substitutions, Classification of substituent groups, Introducing substituent groups in mono and disubstituent benzene ring, Mechanism of nitration, Sulphonation and halogenations reactions in benzene, naphthalene and anthracene, Mechanism in electrophilic aromatic substitution reaction, Resonance and stability, Reactivity and orientation, Theory of orientation, Ortho effect, The effect of halogen on electrophillic aromatic substitution, Bond length, Bond energy, Heat of hydrogenation and stability, Mechanism of acylation, Sandmyer's and Fries reactions in benzene derivatives.

CH 7x04 HETEROCYCLIC COMPOUNDS AND MACROMOLECULES

Synthetic procedure for preparation of heterocyclic compounds: -

Synthesis of imidazole, Thiazole, Oxazole, Benzimidazole, Benzothiazole, Mercaobenzimidazole, Azines, Purines, Tetrazole, Tetrazoline, Pyrrole, Thiophene, Benzopyrimidines, Epoxide, Morpholine, Quinoline, Isoquinoline, Indole, Heterocyclic compounds in biological system viz, cytosine, thiamine, uracil, barbutrate, pesticides, germicides and hetrocyclic amino acid of biological importance, Squelene, Muscones and Coumanes.

CH 7x05 BONDING IN CO-ORDINATION AND ORGANOMETALLIC COMPOUNDS

Bonding models in s, p, d and f-block elements, Covalent, Ionic and coordinate valent bonding, Bonding types in covalent bonding – Sigma (σ), Pi (π), Tau (τ) and delta (δ) bonding, Hybridization, Lewis conce, Valence bond approach of covalent and complex molecules, Crystal field theory and molecular orbital theory (M.O.T) approach to explain magnetic and spectral properties of complex molecules, Spectroscopic terms of orbitals on the basis of Russel Saunder scheme (L-S coupling), Term symbol, Energy state, State terms, Microstate, L-S coupling, j–j coupling, Orgel energy level diagram, Tanabe-Sugano energy level diagram for d^2 and d^9 system.

Hybridization, Types of hybridizations, Their shape and geometry, VSEPR theory and its limitation, Warner conce of primary and secondary valency, Involvement of orbitals in formation of particular geometry of molecules, Shape of hybridized orbital and its quantum mechanical approach, Methods of ascertaining structure and geometry of molecule, The application of uv, infrared spectra and magnetic susceibility measurement. Conce of low spin, High spin, Magnetically dilute, Paramagnetic, Ferromagnetic, Ferrimagnetic, Antiferromagnetic and superexchange interaction in compounds showing anomalous magnetic behaviour. Orbital and spin contribution to magnetic moment value, Queenching of orbital contribution.

ORGANOMETALLIC COMPOUNDS AND COMPOUNDS INVOLVING Π-BONDING LIGANDS

Definition of organometallic complexes and organometallic compounds, Organometallic compounds of Li, Be, Al, Zn, Hg and Sn, Bonding of diene, triene and tetraene with transition metal ions, cyclopentadiene as ligand, Ferrocene and metallocenes, Structure and bonding in ferrocene.

METAL CARBONYL, NITROSYLS, MOLECULAR OXYGEN AND MOLECULAR NITROGEN COMPLEXEX

Characteristic of Π-bonding ligand. Condition pertaining to formation of complexes with Π-bonding ligands (CO, NO, triphenylphosphine, CN, CS and PF_3), Synergic effect, Mono-, di and trinuclear carbonyls of Fe, Co, Ru, Os and Ir. Mixed nitrosyl carbonyl, 18-Electron rules in carbonyl and nitrosyl compound. Magnetic property of carbonyls, Bonding in nitrosyl, Carbonyl , Alkynes and Alkenes.

CH 7x06 TECHNIQUES IN ORGANIC SYNTHESIS AND CHARACTERISATION

Introduction of bromo group to phenol, aniline. Conversion of one nitro group of dinitrobenzene, Conversion of nitrogroup of benzene to phenolic and thiol group. Preparation of oxime from aldehyde and ketone, Osazone formation, Photochemcial bromination.

CH 7x07 STEREOCHEMISTRY

Configuration, Conformation, Stereoisomerism, Configurational nomenclature of cis-trans, R-S, E-Z and Newman projection structure, Chiral center diestereoisomers, Oical activity, Helicity rules, Excitation chirality, Stereoselectivity and stereospecific reactions, Catalytic and enzymatic approaches to stereoselective reaction.

CH 7x08 CHEMISTRY OF NATURAL PRODUCTS

Process of isolation of natural products, Synthesis of Terpines, Camphor, Alkaloids, Atropine, Papaverine, Nicotine, Alizerine, Carotine, Limoneve, Zingiberene, Isoprene, Retinol, Vitamines, Geraneol, Menthol, Carvone etc. their structure and function.

CH 7x09 INORGANIC AND ORGANIC POLYMERS AND METALS CLUSTERS COUMPONDS

Metal cluster, Halide, Cluster of molybdenum, tungsten, Renium, Technitium and Tantanium and their structure, Bonding and reaction with some coordinating molecule like pyridine and dipyridyl, Polymeric inorganic compounds of phosphorous, nitrogen, sulphur with halide, their structure and properties.

SYNTHETIC AND INDUSTRIAL APPROCH TO POLYMER CHEMISTRY

Polymer, Definition, Types of polymer, Nature of linkage, classification on the basis of linkage, Mechanism and structure, Rubber, Resins, Rayons, Plastic and types of plastic (basic approach), Physical properties, degradation, Stabilization, and Fabrication of polymers and rayons.

CH 7x10 QUANTUM CHEMISTRY

Postulates of quantum mechanics, Schrodinger wave equation, Eigen value, Eigen function, Operators, Hermition operator, Angular momentum operator, Angular moment and vector product, Solution of Legendre equation and Legendre polynomials, Normalisation, Normalised and orthogonal wave functions, Transformation of cartizian spherical polar coordinates, Solution of H-like atom, Rigid rotator and harmonic oscillator, Laguerre polynomial, Lagrange's equation, Laplician operator, Ladder operator, Approximation method, Solution of R, θ and φ equation, LCAO method, Huckel theory, Steller determinant, Hartree fock self-consistent field theory, Spectroscopic term symbols for atom, L-S and J-J coupling.

CH 7x11 ORGANIC PHOTOCHEMISTRY AND PERICYCLIC REACTION

Thermal and photochemical reactions, Diels-Elder reaction, Photochemical excited state (Singlet –triplet state), Pericyclic reaction, Cycloaddition, Electrocyclic reaction, Wood-ward Hoffmann rules for electrocyclic reaction, Molecular orbital and orbital symmetry, Conrotatory and disrotatary motion, Mechanism of photochemical and thermal addition, Sigmatropic reaction, Suprafacial and antrafacial addition, Stereoselective and stereospecific reaction regioselectivity.

CH 7x12 WATER AND SOIL ANALYSIS

a. Analysis of Ca, sulphate and halide in water.

b. Determination of B.O.D and C.O.D of river water.

c. Estimation of Ca, Fe and silica of soil samples.

d. Determination of pH, salinity and acidity of soil sample.

CH 7x13 ESTIMATION AND SEPARATION TECHNIQUES OF ANIONS AND CATIONS

a. Estimation of Cd or Zn or Mg by oxinate method.

b. Estimation of Ni or Pd or Co from a complex compound.

c. Estimation of oxalate by $KMnO_4$ from oxalato complex of copper, iron or nickel (II).

d. Use of magnetic susceibility and u-v spectra for evaluating oxidation state of Ni (II) or Co (II) complexes.

CH 7x14 PHYSICAL PROCESS OF REACTIONS

a. Determination of equilibrium constant of base hydrolysis of an ester.

b. Evaluation of order of reaction of bromination of phenol.

c. pH metric and conductometric titrations.

d. Determination of partition coefficient of KI + I_2 in benzene and aqueous solution.

CH 7x15 CHROMATOGRAPHIC SEPARATIONS

TLC, Paper chromatography, Isolation of and solvent extraction by succele extraction procedure. Separation of organic compounds by chromatographic technique.

CH 7x16 SEPARATION AND EXTRACTION OF ORGANIC MOLECULES

a. Isolation of chlorophyll from plant leaf.

b. Extraction of amino acid and protein from fish.

c. Extraction of plant constituents by solvent extraction process.

CH 7x17 COMPLEXES AND THEIR PREPARATION

a. Determination of formation constant of complexes of nickel (II) chloride and morpholine or any base by pH metric method.

b. Determination of stability constant of reaction between Ferric sulphate and potassium thiocyanate by colourimetric procedure.

c. Preparation of tris-oxalato ferrate (III) anion or tris ethylene diamine cobalt (III) or Hexathiocyanatochromium (III) ion.

DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

Courses work of Study for Ph. D (English) Total 16 credits (4X4=16)

HS 7101 English Paper – 1

L-T-P 4-0-0 Credits: 4

1. Historical Survey: Studies of literary gen're and creative works from Chaucer to the end or the 19th century.
2. Detailed study of the following:

(i)	Wordsworth	– Prelude, Book 1
(ii)	Coleridge	– the Rhyme of the Ancient Mariner
(iii)	Byron	– Don Juan, Canto 1
(iv)	Shelly	– Prometheus Inbound
(v)	Keats	– Hyperion
(vi)	Tennyson	– In Memorium
(vii)	Browning	– Men and Women

HS 7102 English Paper – 2

L-T-P 4-0-0 Credits: 4

1. 20th Century Poetry –

(i)	T.S. Eliot	– Four Quartets
(ii)	Poets of the 1930s	– W.H. Auden
		– Stephen Spender

2. A short historical survey of post-modernist poetry

<u>Second Semester</u> Total 8 credits (4x2=8)

HS 7203 English Paper – 3

L-T-P 4-0-0 Credits: 4

20th Century Novel and Drama:

(i) D.H. Lawrence
(ii) Theater of the absurd
(iii) Critical Cross Currents in Literary Criticism:

HS 7204 English Paper – 4

L-T-P 4-0-0 Credits: 4

Specialization Courses: Any one of the following areas to be selected:

(i)	American Novels	– 1800 – 2000
(ii)	Indian writing in English	– 1800 – 2000
(iii)	Afro Asian Writes	– 1800 – 2000
(iv)	Sociolinguistics	

(v) Linguistics and language Teaching
(vi) Dissertation on any modern author
(vii) Descriptive Linguistics

Courses work of Study for Ph. D (Economics) Total 16 credits (4X4=16)

HS 7111 Economics Paper – 1: Research Methodology

L-T-P 4-0-0 **Credits: 4**

1. Meaning, Types and Process of Research
2. Research Problem and Research Design
3. Sampling Design
4. Methods of collection of Data
5. Processing and Analysis of Data
6. Report Writing

HS 7112 Economics Paper – 2: Advanced Microeconomics

L-T-P 4-0-0 **Credits: 4**

1. Introduction
2. Theory of Demand
3. Theory of Production
4. Cost Curves
5. Market Structure and Product Pricing
6. Pricing of Factors of Production
7. Welfare Economics

HS 7213 Economics Paper – 3: Advanced Macroeconomics

L-T-P 4-0-0 **Credits: 4**

1. National Income Accounting
2. Theory of Money and Price
3. Employment and Income
4. Monetary Policy
5. Trade Cycle Theory

HS 7214 Economics Paper – 4: Indian Rural Development

L-T-P 4-0-0 **Credits: 4**

1. Basic Features of Indian Economy
2. Planning in India for rural development
3. Demographic Features, Poverty, Inequality and Unemployment
4. The Agricultural Sector – Land utilization pattern, Cropping pattern, Food problem and Food security for sustainable development
5. The Industrial Sector – Village, Small and Ancillary Industries
6. Rural Credit in India – Micro financing, NABARD, Regional Rural Bank, Role of various other agencies, SHG, NGO
7. Agriculture Marketing system and structure in India
8. Economic Reform – Globalization and Rural Development

DEPARTMENT OF CIVIL ENGINEERING

CE 7x01 System Analysis and Optimization Techniques

(Syllabus same as of CE 2101 for M. Tech Civil Engg)

L-T-P: 3-1-0 **Credits: 4**

Theory:

System Engineering: Definition of a system, systems approach, linear, non-linear, deterministic and stochastic systems, Network Techniques, Transportation and transshipment assignment models. Optimization: Introduction, definitions, system variables, objective functions, constraints. Linear programming formulations, standard form, graphical solution, simplex algorithm, matrix formulation of L.P. and revised simplex method, duality, primal-dual algorithm, Integer linear programming. Non-linear programming, convex and concave functions, unconstrained optimization, uni-variate method, Powell's method, Gradient Method, constrained problems by unconstrained optimization, interior and exterior penalty functions, direct method of constrained optimization, Lagrange Multipliers, Kuhn Tucker conditions, Quadratic Programming, Introduction to Dynamic programming, geometric and stochastic programming.

Reference Book:

1. Taha, Hamdy A., Operation Research: An Introduction, Prentice Hall.

CE 7x02 Construction Technology

(Syllabus same as of CE 2102 for M. Tech Civil Engg)

L-T-P: 3-1-0 **Credits: 4**

Theory:

Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT Modeling, Time-cost Trade-offs, Linear Programming and Network Flow Formulations, PERT/COST Accounting. Scheduling with limited resources, Resource Planning, Leveling, Resource Allocation, Project Schedule Compression, Project Scheduling Software, Precedence Diagrams, Decision CPM, Generalized Activity Networks, GERT. Factors affecting selection of equipment - technical and economic, construction engineering fundamentals, Analysis of production outputs and costs, Characteristics and performances of equipment for Earth moving, Erection, Material transport, Pile driving, Dewatering, Concrete construction (including batching, mixing, transport, and placement) and Tunneling. Introduction to prefabrication, modular coordination and standardization of building components. Contract types, salient features and conditions.

CE 7234 Concrete Technology

(Syllabus same as of CE 2234 for M. Tech Civil Engg)

L-T-P: 3-1-0 **Credits: 4**

Theory:

Types of Cement and additives, properties and testes on cement. Review of properties of fresh and hardened concrete, workability, segregation, bleeding, strength, elasticity, shrinkage, creep, durability, constituents of concrete and mix design, tests on concrete. High strength concrete; High density and lightweight concretes; Concreting under extreme weather conditions; Behavior of concrete under aggressive environmental conditions including temp; Admixtures; Polymers in concrete; Fiber reinforced concrete; Fracture mechanics of concrete; Repairs and rehabilitation of old concrete.

CE 7x03 Fundamentals of Earthquake Engineering

L-T-P: 3-1-0 **Credit: 4**

Total Lecture 14x4 = 46

Learning Objectives: At the end of the course the student will understand the

- Dynamics of earthquakes
- Seismic Instrumentation in India
- Seismic hazards in India
- Mechanism of Formation of Tsunamis
- Status of earthquake prediction in India

1. **Introduction:** Composition of the earth, probing the earth's interior, basic geography and tectonic features what causes earthquakes**?** Earthquake Phenomenon, epicentre, hypocentre and earthquake waves, magnitude of earthquakes and energy released **(6 Lectures)**

2. **Terminology:**, types of earthquakes and fault, seismic waves, magnitude, intensity, Magnitude and intensity, magnitude and energy of an earthquake **(05 Lectures)**

3. **Engineering Seismology**: Definitions, seismic signal processing, introduction to seismic hazards, strong motion vibration records, earthquake spectrum and design spectrum, Ground motion and effect of ground motion, seismicity- global and local, Estimation of Earthquake Parameters, relationship of fault length, affected area and duration with magnitude **(12 lectures)**

4. **Seismic Instrumentation:** whether earthquake prediction is possible? short term prediction of earthquakes, earthquake prediction in India, earthquake measuring instruments, earthquake measurement, introduction to seismic hazards **(12 Lectures**)

5. **Tsunamis:** What is a tsunami? How is it caused? How destructive is it? Tsunami disaster management **(05 Lectures)**

6. **Past earthquakes in India:** Prominent past earthquakes in India, Lessons learnt from past earthquake, seismic zones of India **(05 Lectures)**

7. **Disaster preparedness and its mitigation by people, Seismic hazard assessment**, consequences of earthquakes, Venerability Assessment of Existing Buildings/Other Eivil Engineering Structures, risk maps **(05 Lectures)**

8. **Case studies (minimum three)** **(06 Lectures)**

Assignments and Term paper: There will be a minimum of three assignments. The term paper will be a comprehensive summary (approximately 10 typed pages) of study on a topic of the interest of the student and related to earthquake engineering. The student may choose a topic from professional journals, conference proceedings or other sources. The student should assume that the readers of the paper will be his classmates.

Text Books:

1. Naemin F, Ed..2001. '**The Seismic Design Handbook'**, Kluver Academic Publishers, Boston, USA.
2. Ambrose J. and D. Vergun .1999. '**Design for Earthquakes'**, John Wiley & sons, Inc., New York.
3. D. Venkat Reddy Ed 2010, '**Engineering Geology'**, Vikas Publishing House PVT. LTD.

CE 7x04 Laboratory Works in Earthquake Engineering

L-T-P: 0-0-6 **Credit: 4**

Total Lecture 14x6 = 84

Learning Objectives: At the end of the course the student will be able to have the practical experience of

- The composition of the earth and its interior
- Application of Seismic Instruments
- Risk maps and its applications
- Mechanism of Formation of Tsunamis
- Status of earthquake prediction in India
- Artificial earthquakes through Shake table Experiment

Note: The student will perform **at least eight experiments** related with topics mentioned above. Also the student will conduct these experiments at School of the Earthquake Engineering at IIT Roorkee and or at Bhabha Atomic Research Centre, Mumbai or at any other Institutes of repute in the field of earthquake engineering. The student will also **attend one/ two weeks training Program** at such Institutes on the topics related with Earthquake engineering.

MA 7x06 Advance Numerical Methods and Computational Techniques

(Syllabus same as of MA 2106 for M. Tech Civil Engg)

L-T-P: 3-1-0 **Credit: 4**

Theory:

Interpolation and extrapolation, Newton backward and forward formula, Gauss backward and forward and Sterling formula for equal intervals, Lagrange's formula for unequal intervals, form of error terms.

Numerical Integration: Newton-Cotes and open integration formulas and their integration errors, Composite integration formulae, Numerical integration with unequally spaced base points.

Ordinary Differential Equations: Euler's Method, Runge Kutta Method, Truncation Error, Stability and step size in Runge Kutta Algorithm, Open and closed integration formula, Predictor corrector method.

Solution of Equations: Iterative factorization of polynomials, method of successive substitution, Newton's method, Regula Falsi Method.

System of Equations: Gauss Elimination method, Gauss Jordan method, Jacobi iterative method, Gauss Seidal iterative method.

Matrices: Matrix Polynomial, characteristics of equation, eigen value and eigen vectors, reduction to diagonal form, application of solution to linear simultaneous equation.

Computer programming in C++ language, Algorithm and flow diagrams, constants, variables, expressions, data types (system and user defined), statements, arithmetic statements, sub-routines, functions, function and programmes,

Tutorial Assignments based on numerical methods: Runge Kutta method for solution of ODE, Gauss Elimination Method, Generation of finite difference table, Roots of algebraic equation.

Text books:

1. Advance Engineering Mathematics- E. Kreyszig, 8th edition, John Wiley & Sons. New York
2. Numerical Methods for Scientific & Engineering Computations- M. K. Jain. S.R.K. Iyenger & R. K. Jain, New Age International Publishers, New Delhi.
3. Introductory Method of Numerical Analysis — S.S. Sastry — Prentice hail of India Pvt. Ltd.

Reference books:

1. Numerical methods for mathematics, science and engineering, Mathews, Prentice Hall of India.

Environmental Engineering

CE 7x71 Wastewater Flow and Quality Management

Credits: 4 **L-T-P: 4-0-0**

Introduction to wastewater flow measurement, Location of flow measurement (Lectures: 3)

Flow measurement methods, Direct discharge methods-California pipe, Manning's formula, Weirs and Notches, Velocity-Area methods, Current meter, Float measurements (Lectures:12)

Municipal water demand, Relation between water supply and wastewater flow rates. (Lectures: 4)

Introduction to Wastewater Quality, Physical Quality, Chemical Quality Biological Quality, Biochemical Oxygen Demand, Chemical Oxygen Demand (Lectures:12)

Effluent Standards, Typical Wastewater Characteristics of domestic and industrial Wastewater (Lectures:6)

Wastewater characteristics for various beneficial uses of surface water, River Zoning based on Water Quality (Lectures:3)

Importance of wastewater flow measurement and wastewater characterization for planning of wastewater treatment plants (Lectures:2)

CE 7x72 Physico-Chemical Processes for Wastewater Treatment

Credits: 4 L-T-P: 4-0-0

Basic considerations for wastewater treatment: Initial and design years, Service area, site selection, design population, design flow (Lectures: 5)

Degree of treatment, Choice of treatment, Process flow Schemes and comparison of alternatives (Lectures: 4)

Screenings and Grit removals: Fine, medium and course screens, mechanically and manually cleaned screens; Design of grit chambers (Lectures: 8)

Coagulation and Flocculation processes, Chemicals used in coagulation and Flocculation Processes (Lectures: 8)

Sedimentation: Discrete settling, Flocculent Settling Design Considerations and criteria, Factors influencing design, Performance (Lectures:12)

Operation and maintenance and trouble shootings at Screens, Grit Chambers and Sedimentation facilities (Lectures:5)

CE 7x73 Biological Processes for Wastewater Treatment

Credits: 4 L-T-P: 4-0-0

Fundamentals of Biological wastewater treatment (Lectures:3)

Suspended Growth Biological Treatment, Attached Growth Biological Treatment (Lectures:5)

Activated Sludge Process Variables: Loading rates, Mixing regime, Flow Schemes, Conventional System and modification: completely mixed, Extended Aeration, Design Consideration, Aeration tank, Oxygen requirements, Diffused Air Aeration and Surface Aerators, Secondary Settling Tank, Sludge recycle Excess Sludge Wasting (Lectures:15)

Microbial Process Control Parameters in Treatment plants (Solid retention time, Food micro-organism ratio Sludge volume index, influence of dissolved oxygen (Lectures:5)

Problems related to micro-organisms in treatment plants (Sludge Bulking, Foaming and Frothing, Sludge rising) (Lectures:3)

Trickling Filters: Process Description, Types of filters (Lectures:3)

Stabilization Ponds: Classification, mechanism of purification (Lectures:3)

Anaerobic Treatment of Wastewater: Introduction, High rate Anaerobic System, Up flow Anaerobic Sludge Blanket Reactor (Lectures:5)

CE 7x95 Research Seminar

Credits: 4 L-T-P: 0-0-6

Candidate should have to give at least two seminar on the topic related to his research work. The final / end semester evaluation shall be done by a panel of examiners consisting of two experts nominated by HOD and the Supervisor(s)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CS 7x22 Genetic Algorithm (CS 2x22)

L – T – P: 3 – 1 – 0 **Credit: 4**

Introduction: A brief history of evolutionary computation, Elements of Genetic Algorithms, A simple genetic algorithm, Applications of genetic algorithms

Genetic Algorithms in Scientific models: Evolving computer programs, data analysis & prediction, evolving neural networks, Modeling interaction between learning & evolution, modeling sexual selection, measuring evolutionary activity.

Theoretical Foundation of genetic algorithm: Schemas & Two-Armed and k-armed problem, royal roads, exact mathematical models of simple genetic algorithms, Statistical- Mechanics Approaches.

Computer Implementation of Genetic Algorithm: Data structures, Reproduction, crossover & mutation, mapping objective functions to fitness form, fitness scaling, coding, a multiparameter, mapped, fixed point coding, discretization and constraints.

Some applications of genetic algorithms: The risk of genetic algorithms, De Jong & function optimization, Improvement in basic techniques, current application of genetic algorithms

Advanced operators & techniques in genetic search: Dominance, duplicity, & abeyance, inversion & other reordering operators. Other micro operators, Niche & speciation, multiobjective optimization, knowledge based techniques, genetic algorithms & parallel processors.

Text / Reference Books:

1. Genetic algorithms in search, optimization & Machine Learning by David E. Goldberg, Pearson Education
2. An introduction to genetic algorithms by Melanle Mitchell, PHI.
3. The simple genetic algorithm foundations and theory by Michael D. Vose, PHI

CS 7x95 Research Seminar

Credits: 4 L-T-P: 0-0-6

Candidate should have to give at least two seminar on the topic related to his research work. The final / end semester evaluation shall be done by a panel of examiners consisting of two experts nominated by HOD and the Supervisor(s)

DEPARTMENT OF ELECTRICAL ENGINEERING

EE 7x70 Neural Network and Application (EE 2x70)

L-T-P: 3-0-3 Credit-5

1. Biological neurons and memory: Structure and function of a single neuron, Biological memory mechanisms, Neural basis for human memory. Neuron models, 6 Lectures
2. Artificial Neural Networks (ANN), Classification, Clustering, Vector Quantization, Basic Approach of the working of ANN - Training, Learning and Generalization. 6 Lectures
3. Supervised Learning: Single-layer networks, Training algorithm, Limitations, Multi-layer networks-Architecture, Back Propagation Algorithm (BTA), Recurrent Networks, Feed-forward networks 12 Lectures
4. Unsupervised Learning: Winner-takes-all networks, Simple competitive learning, Counter propagation networks; Adaptive Resonance Theory, Kohonen's Self-organizing Maps. 12 Lectures
5. Application of neural network, Hopfield Networks, Brain-in-a-Box network, 6 Lectures

Texts Books

1. K. Mehrotra, C.K. Mohan and Sanjay Ranka, Elements of Artificial Neural Networks, MIT Press, 1997 - [Indian Reprint Penram International Publishing (India), 1997]
2. Simon Haykin, Neural Networks - A Comprehensive Foundation, Macmillan Publishing Co., New York, 1994.

References Books

3. A Cichocki and R. Unbehauen, Neural Networks for Optimization and Signal Processing, John Wiley and Sons, 1993.
4. J. M. Zurada, Introduction to Artificial Neural Networks, (Indian edition) Jaico Publishers, Mumbai, 1997.

EE 7x95 Research Seminar

Credits: 4 L-T-P: 0-0-6

Candidate should have to give at least two seminar on the topic related to his research work. The final / end semester evaluation shall be done by a panel of examiners consisting of two experts nominated by HOD and the Supervisor(s)

DEPARTMENT OF MECHANICAL ENGINEERING

ME 7x01 Research Methodology

L-T-P: 4-0-0 **Credits: 4**

1. Research Methodology: Introduction, Types of Research, Research Processes. Lectures 07

2. Data Collection and Presentation: Primary and Secondary data, Fundamentals of data collection methods, Analysis of Variance (ANOVA), Latin Square Design, Duncan's Multiple Range Test, Factorial Design, Expected Mean Square (EMS) Rule, Data Presentation. Lectures 07

3. Scales: Types of Scales, Scales for Stimuli, Scaling Respondents. Lectures 07

4. Probability Distribution: Binomial, Poisson, Uniform, Exponential and Normal Distribution. Lectures 07

5. Sampling Methods and Distribution: Sampling Methods, Sampling distribution of Mean, Variance and Proportion. Lectures 07

6. Modeling and Simulation: Steps of Modeling, Operations Research Models, Applications of Models, Need and Types of Simulation, Simulation Languages Lectures 07

Text/Reference Book

1. R. Panneerselvam, Research Methodology, PHI Learning Private Ltd. New Delhi.
2. C. R. Kothari, Research Methodology : Methods and Techniques, 2nd revised edition, New Age International (P) Limited Publishers, New Delhi.

ME 7x02 Experimental Methods

L-T-P: 4-0-0 **Credits: 4**

1. Introduction: Calibration, Standards, The generalised Measurement System, Basic concepts in Dynamic Measurements, System Response, Distortion, Impedance matching. Lectures-05

2. Analysis of Experimental Data: Causes and Types of Experimental errors, Error Analysis on a Common sense basis, Uncertainties Analysis, Evaluation of Uncertainties for Complicated Data reduction, Statistical Analysis of Experimental Data, Probability distribution, The Gaussian or Normal Error distribution, Comparison of Data with Normal distribution, The Chi-Square Test of Goodness of Fit, Method of Least Squares, The Correlation Coefficients, Multivariable Regression, Graphical Analysis and Curve Fitting, General consideration in Data Analysis. Lectures-15

3. Air Pollution: Air Pollution standards, General Air Sampling Train, Gas Sampling Techniques, Particulate Sampling Techniques. Lectures-05

4. Data Acquisition and Processing: The General Data Acquisition System, Signal Conditioning, Data Transmission, Analog-to-Digital and Digital-to-Analog Conversion, Data Storage and Display. Lectures-10

5. Design of Experiments: Experimental planning, Types of Experiment, Experiment Design Factors and Protocol. Lectures-07

Text/Reference Book:

1. Holman, J.P. : Experimental Methods for Engineers; 7th ed, TMH Education Private Limited, New Delhi,2007
2. Doeblin, E.O. : Measurement Systems : Analysis and Design, 4th ed, McGraw Hill, New York,1990

ME 7x03 Mechanical Engineering Lab.

L-T-P: 0-0-6 **Credits: 4**

1. To determine the BHP, Brake specific fuel consumption and Brake Thermal Efficiency of the Ruston oil Engine.
2. To determine the Sp. Fuel consumption, IHP,BHP, Mech. Efficiency and Brake Thermal efficiency under varying load and to draw the performance curves and Heat Balancing Sheet by Morse Test and also to find IHP for individual cylinder.
3. To study the working of a 4-Stroke 10 H.P. single cylinder, Horizontal Diesel Engine and to draw the Heat Balance Sheet.
4. To study the Valve mechanism of I.C. Engine and to draw Valve timing diagram of a four cylinder vertical Petrol engine and a single cylinder vertical Diesel engine.
5. To study Heat Transfer from a Pin-Fin Apparatus.
6. To determine the Heat Transfer Coefficient in Unsteady Heat Transfer.
7. To determine the Surface Heat Transfer Coefficient for a Vertical cylinder losing heat by Natural Convection.
8. To determine the flame emissivity and the flame temperature using Optical Pyrometer.
9. To determine the Overall Heat Transfer Coefficient for a Tube-in-tube Heat Exchanger.
10. To determine the COP of the Hilton Thermo-electric Heat Pump.
11. Analysis of Pressure distribution in Hydrodynamic lubrication of Journal Bearing.
12. Motion analysis of different CAM and Follower pairs.
13. To study forced vibration of an equivalent spring-mass system.
14. To study the torsional vibration (undamped) of single motor shaft system.
15. To determine the Coefficient of discharge of water using Venturimeter and to perform Calibration test by using ideal Venturimeter.
16. Calibration test of Pressure gage using Bourdon-tube pressure gage.
17. To find out the Stiffness of the metal piece by Impact Testing Machine.
18. Torsion test on metals and pipes.
19. Brinell's Hardness Test on metal piece.
20. Vicker's Hardness Test on metal piece.
21. Tension test and Compression test on metal piece by using Universal Testing Machine.

Note: Out of 21experiments, at least 14 experiments should be performed and report should be submitted.

ME 7x95 Research Seminar

Credits: 4 L-T-P: 0-0-6

Candidate should have to give at least two seminar on the topic related to his research work. The final / end semester evaluation shall be done by a panel of examiners consisting of two experts nominated by HOD and the Supervisor(s)

ME 7x04 Computational Fluid Dynamics

L-T-P: 4-0-0 **Credits: 4**

1. Introduction: Philosophy of Computational Fluid Dynamics. The governing equations of Fluid Dynamics and their derivations. Lectures 10
2. Partial Differential Equations: Mathematical behaviour of partial Differential Equations and its impact on CFD Lectures 10
3. Numerical Methods: Basic aspects of discretization, Grids and Meshes, Some simple CFD techniques. Lectures 10
4. Applications of CFD: Numerical solution of One Dimensional Steady/ Unsteady State system, Numerical solution of two dimensional Steady/Unsteady state System, Numerical solution of incompressible Couette flow by means of an implicit method and the Pressure correction method. Lectures 12

Text /Reference Books

1. Anderson , J. : Computational Fluid Dynamics, McGraw-Hill Education, 1995
2. Date, A. W.: Introduction to Computational Fluid Dynamics, Cambridge University Press, 2005.
3. Abbott, M. B. and Basco, D. R.: Computational Fluid Dynamics. An Introduction for Engineers, Longman, Harlow, 1989.
4. Sengupta, T. P.: Fundamental of Computational Fluid Dynamics, Orient Longman, Hyderabad, India, 2004.
5. Cebeci, T.: Computational Fluid Dynamics for Engineers, Springer- Verlag, New York, 2005.
6. Patankar, S. V. : Numerical Fluid Flow and Heat Transfer, Hemisphere, New York, 1981

ME 7162 Advanced Thermodynamics

L-T-P: 3-1-0 **Credits: 4**

1 Application of thermodynamics to pure substances; mathematical theorem, Maxwell equation, T-d's equation, energy equations, difference in heat capacities, clapeyron relation - **Lectures 09**

2 Equation of state: vander waal berthelet, dietrici, redlich kwong equations of state - **Lectures 06**

3 Entropy: the essence of entropy, statistical definition, allowed, quantum state probabilities, entropy definition, characteristics of entropy, thermodynamics, definition of temperature and pressure, TER and MER constituent reservoir. - **Lectures 09**

4 Irreversible thermodynamics: reversible and irreversible processes, the flux postulate, entropy production, heat flux, thermoelectric phenomenon, thermodynamic analysis of the thermocouple, onsager's, reciprocal relation. - **Lectures 09**

5 Thermodynamic equilibrium: equilibrium and stability, condition for chemical equilibrium, equilibrium and third law, phase equilibrium, chemical reaction, equations of reaction equilibrium, the phase rule, the chemical potential of ideal gasses, fugacity **Lectures 09**

Text Book:

1. Engineering thermodynamics – Reynolds WC and Perkins HC (MGH)
2. Advanced Engg thermo – Adman Dejan (John Willey)
3. Thermodynamics for engineers – Michel A saad (PHI)
4. Engineering thermodynamics – Jones and Hawkines (John willey)
5. Engineering thermodynamics – JP Holman (MGH)
6. Thermodynamics – JH Keenan (John Willey)