**Department of Pharmaceutical Sciences, GJUS&T, Hisar**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course code** | | **Course** | **Internal assessment** | | |  | **End semester**  **Exams** | | **Total Marks** | **Credits** |
| **Continuous mode** | **Minor Exam** | | **Total** |
|  | |  |  | **Marks** | **Duration** |  | **Marks** | **Duration** |  |
| **PPD101** | | **Research methodology** | 10 | 20 | I h | 30 | 70 | 3h | 100 | 4 |
| **PPD102** | | **Review of literature and Seminar** | 50 | -- | -- | 50 | -- | -- | 50 | 2 |
| **PPD 103**  ADVANCES IN PHARMACEUTICAL SCIENCES  **(Elective)** | **A** | **Pharmaceutics** | 10 | 20 | 1h | 30 | 70 | 3h | 100 | 4 |
| **B** | **Pharmaceutical chemistry** | 10 | 20 | 1h | 30 | 70 | 3h | 100 | 4 |
| **C** | **Pharmacology** | 10 | 20 | 1h | 30 | 70 | 3h | 100 | 4 |
| **D** | **Pharmacognosy** | 10 | 20 | 1h | 30 | 70 | 3h | 100 | 4 |
| **PPD 104** | | **Research & Publication Ethics** | 10 | 20 | 1h | 30 | 70 | 2h | 50 | 2 |
| **Total** | |  |  |  |  |  |  |  | 300 | 12 |

**Scheme for PhD course work:**

**Course Assessment Method:**

Internal Examination (30 marks):

Two minor tests each of 20 marks will be conducted. The highest marks obtained by a student in any of the two minor examinations will be considered. Class performance will be measured through percentage of lectures attended (04 marks), Assignments, quiz, etc. (06 marks).

External End semester examination (70 marks): The examiner is required to set 9 questions in all. The first question will be compulsory covering the entire syllabus and consisting of 4 short answers type questions of 3.5 marks each.

In addition to that, 8 questions have to be set consisting of 2 questions from each unit. A candidate is required to attempt 05 questions in all, selecting one question from each unit.

The compulsory question No 1. All questions carry equal marks.

**Department of Pharmaceutical Sciences, GJUST, Hisar**

**Syllabus for PhD course work**

**PPD 101: Research Methodology (Science Discipline) 04 credits, MM:100**

**Unit -1**

**Introduction to Research Methodology**: Meaning, Objectives, Types and Significance of research, Creativity and Innovation, Hypothesis formulation and development of Research plan.

**Research Problem:** Definition, necessity and techniques of defining the research problem.

**Library**: Classification system, e-library, Reference management, Web based literature search engines.

**Use of modern aids**: Making technical presentation, Research and academic integrity: Avoiding Plagiarism using software. Copy right issues, ethics in research, Intellectual Property Rights (IPRs) & patent Law.

**Unit -II**

**Scientific Communications**: Role and importance of communications, Effective oral and Written Communication, Scientific and Research paper writing, technical report writing.

Making Research & Development (R&D) proposals.

**Publishing Research paper:** Selection of journal, formulation of problem, discussion and references, Submission and handling of reviewers’ comments.

**Writing of thesis**: Format of thesis, Review of literature, Formulation: Writing methods,

result, preparation of tables, figures; writing discussion: writing conclusion; Writing summary and synopsis; Reference citing and listing/ Bibliography.

**Laboratory safety issues:** Related to various labs, Workshop, electrical, health and fire safety, safe disposal of hazardous materials.

**Unit-III**

**Statistical analysis and errors**: Mean, Mode, Median, Relative and absolute errors, Hypothesis testing for mean, proportion and variance, Chi-square tests, Correlation and regression analysis, Factor analysis.

Linear and non-linear least squares fitting methods. Interpolation methods including cubic splines, Fourier Series Analysis, Fast Fourier Transform, Convolution and Correlation.

**Unit-IV**

**Computational tools and Programming:** Resume of Practical approach of learning operating systems (DOS, Windows, UNIX), Graphical packages, Calculations using Spreadsheet programming. Technical research paper writing in Latex. Introduction to HTML, XML & programming languages, an overview of Modelling and simulation software's,

**Online Resources**: Introduction to Massive Open Online Courses (MOOCs) and Study Webs of Active Learning for Young Aspiring Minds (SWAYAM), Indexing and abstracting services, Citation index and impact factor, Research quality parameters and indicators

**References:**

**1.** Gurumani, N. (2010), Scientific thesis writing and Paper presentation, MJP publishers.

2. Gerald, C.F. and Wheatley, P.O. (2002) Applied numerical analysis, 6th Ed, Addison Wesley.

3. Smith G.D., (1982) Numerical solution of partial differential equation, Oxford University Press.

4. Schwartz H.R., Rutishauser H. Stiefel E. et al (1976) Numerical analysis of symmetric matric Prentic Hall.

5. C.R. Kothari & Gaurav Garg (2014), Research Methodology, Third Edition, New A International Publishers.

6. Web resources: www.sciencedirect.com for journal references, www.aip.org and www.aps for references styles.

7. Web Resources: www.nature.com, [www.science](http://www.science) marg.org, www.springer.com,www.pnas.or www.tandf.co.uk,www.opticsinfobase.org for research updates.

**PPD 102: Review of literature and Seminar 02 credits, MM:50**

1. The research student is required to prepare a concept paper/working paper/ review paper by reviewing 20-30 research papers/ reference books/ unpublished Doctoral dissertations/ other reports, etc. and/or make a presentation in the presence of a duly constituted committee.

2. A committee of three teachers of the department duly constituted by the Dean and headed by the Chairperson or senior teacher of the department shall evaluate the completion of the paper.

**ELECTIVES (PPD 103):**

**ADVANCES IN PHARMACEUTICAL SCIENCES (04 credits each):**

**Duration: One semester, MM 100.**

**Credits: 04**

It comprises of four subjects, one from each specialization.

i) The candidates admitted to PhD course work will have to opt for any one of the following elective subjects.

ii) There would be one minor test of 20 marks.

iii) The internal assessment would comprise of 20 marks (minor exam) and 10 marks for conduct/attendance.

iv) The Major test would be of three hours duration and 70 marks.

v) In the THEORY major exam, the student shall attempt five out of eight questions. Question no. 1will be **compulsory** short answer question (**4 parts of 3.5 marks** each). There will be 2 questions from each unit, out of which one question needs to be attempted. Each question shall carry equal marks.

**Elective-1**:

**Advances in Pharmaceutical Sciences: Pharmaceutics (PPD-103 A)**

**Unit I**

* Introduction to Novel Drug Delivery Systems (NDDS)
* Gastroretentive Drug Delivery Systems (GRDDS)
* Ocular Drug Delivery Systems
* Transdermal and Nasal Drug Delivery Systems
* Nano Particulate Drug Delivery Systems: Liposomes, Niosomes, SLNs, NLCs
* Stimuli responsive polymers

**Unit II**

* Introduction and Classification of Polymers in Pharmaceutics
* General Methods of Polymer Production:
  + Polymerization, Polycondensation, Polyaddition
* Key Pharmaceutical Polymers:
  + Chitosan, Gellan gum, Xanthan gum, Pectin, Alginic acid, Pullulan, Curdlan, Guar Gum.
  + Eudragits, N-isopropyl acrylamide (NIPAAM), Polyethylene oxide (PEO), Polyvinyl alcohol (PVA).

**Unit III**

* Microfluidics in Nanoparticle and Emulsion Preparation
* Electrospinning in Pharmaceutics: Nanofiber Fabrication and Applications
* Microneedle Fabrication Techniques and Emerging Applications
* Advanced Solubilization Techniques for Poorly Soluble Drugs:
  + Supercritical Fluid Technology
  + Lipid-Based Systems
  + Amorphous Solid Dispersions

**Unit IV**

* Artificial Intelligence (AI) and Machine Learning in Drug Development
* Electronic Drug Delivery Systems.
* Blockchain in Pharmaceutical Supply Chain: Ensuring Drug Safety and Traceability
* Wearable Drug Delivery Devices.

**Elective-II**

**Course Title:** Advances in Pharmaceutical Sciences: Pharmaceutical Chemistry (PPD-103 B)

**Unit I**

**Fundamentals of Peptide Chemistry:** Introduction, Importance of Peptides in drug discovery, Peptides as drugs or diagnostic tools, Classification of amino acids, Introduction to solution phase and solid phase peptide synthesis. **Protection and Deprotection:** Introduction to the basic concept, Minimal versus global protection, Protection of amino group by acid and base labile groups, **Peptide Synthesis:** Coupling reagents, solid supports for peptide synthesis, Various methodologies employed for coupling reaction, t-BOC and FMOC protocols, peptide bond formation, deprotection and cleavage from resin and recent advancements.

**Unit II**

**QSAR:** Introduction, history, applications, various descriptors used in QSARs: lipophilicity, electronic, steric based descriptors. **2D QSAR:** 2D QSAR techniques like Free-Wilson Analysis, Ban-Fujita modification, Topliss operational scheme, Craig Plot, Cluster Analysis and Hansch analysis. **3D QSAR:** COMFA – 3D QSAR techniques like Comparative molecular field analysis, CoMSIA- Comparative Molecular Similarity Indices Analysis **Virtual Screening and Molecular docking:** Concept of virtual screening and its importance, Drug likeness screening, Molecular docking: Rigid and flexible docking, steps involved and validation of molecular docking and recent advancements.

**Unit III**

**Introduction to green chemistry:** Need and goals. Green chemistry and sustainability, Basic principles of green chemistry. Different approaches to green synthesis, Use of green reagents in green synthesis: polymer supported reagents, polymer supported peptide coupling reagents. Green catalysts, Phase-transfer catalysts in green synthesis. **Organic synthesis in aqueous phase and in solid state:** Aqueous reactions. Solid state reactions (i) Solid phase synthesis without using any solvent (ii) Solid supported synthesis, microwave-assisted synthesis and recent advancements.

**Unit IV**

**Asymmetric synthesis:** Active substrate, active reagent, active catalyst or solvent, reactions in the presence of circularly polarized light, methods of resolution including conversion to diastereomers, differential absorption, chiral recognition, biochemical processes, mechanical separation, kinetic resolution, deracemization *etc.* and recent advancements.

**Elective -III**

**Advances in pharmaceutical sciences: pharmacology (PPD-103C)**

**UNIT-I**

* CCSEA guidelines to conduct experiments on animals. Good laboratory practice as per OECD.
* Pre-clinical screening methods for evaluation of CNS stimulants and depressants, muscle relaxants, anxiolytics, antidepressants, anti-psychotics, anti-epileptics, nootropics, anti-stroke, and anti-Parkinsonian drugs.

**UNIT-II**

* Pre-clinical screening methods for evaluation of anti-asthmatics, anti-allergics, antifertility and anti-diabetic agents.
* Pre-clinical screening methods for evaluation of analgesics, anti-inflammatory drugs, antipyretics, anti-ulcer drugs, anti-emetics, antidiarrheal drugs, and laxatives.

**UNIT-III**

* Pre-clinical screening methods for evaluation of antihypertensives, anti-arrhythmics, antianginal, anti-atherosclerotic agents, diuretics, and anti-obesity drugs.
* Acute, sub-acute and chronic oral toxicity studies; and acute dermal toxicity study as per OECD guidelines.

**UNIT-IV**

* Acute eye irritation, skin sensitization, dermal irritation and reproductives toxicity studies as per OECD guidelines.
* Safety pharmacology studies. Alternatives to animals for pharmacological screening and toxicity testing of drugs.

**Elective -IV**

**Advances in pharmaceutical sciences: pharmacognosy (PPD-103D)**

**UNIT-I**

* Introduction about natural products, use of natural products in traditional medicines and their role in drug discovery.
* Emerging trends in natural drug development.

**Unit II**

* Conventional and Modern Extraction Techniques: Introduction, principle and applications of different extraction and isolation methods. Role and applications of chromatographic techniques in isolation and identification of bioactive compounds.
* Advanced Structure Elucidation Techniques for Natural   Products:Basic principles, definitions and explanation of concepts of spectroscopic methods.

**Unit III**

* Basics of Novel Herbal formulations: Phytosomes, Liposomes, Novel vesicular herbal formulations etc.
* *In vitro* and *In vivo* experimental models for biological activities

**Unit IV**

* WHO Guidelines for assessment of crude drugs.
* Herbal Drug Regulatory Affairs: Role and importance of national and international regulatory bodies in the assessment of quality of herbal products and formulations.

**PPD 104: Research and Publication Ethics (RPE) 02 credits**

THEORY

* RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)

l. Introduction to philosophy: definition, nature and scope, concept, branches

2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

 RPE 02: SCIENTIFICCONDUCT (5 hrs.)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity.
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

 RPE 03: PUBLICATION ETHICS (7 hrs.)

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WA-ME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

 RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)

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

 RPE 05: PUBLICATION MISCONDUCT (4hrs.)

1. Group Discussions (2 hrs.)

l. Subject specific ethical issues, FFP, authorship

* 1. Conflicts of interest
  2. Complaints and appeals: examples and fraud from India and abroad

1. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

 RPE 06: DATABASES AND RESEARCH METRICS (7 hrs.)

1. Databases (4 hrs.)
   1. Indexing databases
   2. Citation databases: Web of Science, Scopus etc.
2. Research Metrics (3 hrs.)
   1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
   2. Metrics: h-index, g index, i10 index, altmetrics