DEPARTMENT OF PHARMACEUTICAL SCIENCES
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR
Syllabus for Entrance Examination for admission to

PhD in Pharmaceutical Sciences

Note: The Syllabus consists of two sections (A and B). The examiner will set 50 multiple choice questions from Section-A and B (Pharmaceutical Chemistry /Pharmaceutics/ Pharmacology/ Pharmacognosy)

	Questions
Section A: Research Methodology and Analytical Techniques	**35**
Part I	
General Research Methodology: Research objective, requirements. practical difficulties, review of literature, study design, types of studies. strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques. **Biostatistics:** Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance. **Pre-Clinical and Clinical Research:** Definition, importance, types and practices, phases of clinical trials, ethics in pre-Clinical studies. Research ethics, informed consent, confidentiality, guidelines, ethics committees. **CPCSEA guidelines for laboratory animal facility:** Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anaesthesia, euthanasia. physical facilities, environment, animal husbandry, record keeping. SOPS. personnel and training, transport of lab animals.	
Part II	**15**
UV-Visible Spectroscopy: Theory, Beer-Lambert's Law, Instrumentation of UV-Visible Spectrophotometer, choice of solvents and solvent effect. Woodward- Fieser rules for 1,3-Butadienes, cyclic dienes and a, B unsaturated carbonyl compounds **IR Spectroscopy:** Theory, modes of molecular vibrations, instrumentation of IR spectrometers, factors affecting vibrational frequency, Interpretation of IR spectrum of organic compounds. **NMR spectroscopy:** Theory of NMR spectroscopy, role of quantum numbers in NMR, instrumentation, relaxation process in NMR, solvent requirement in NMR, chemical shift, factors influencing chemical shift, spin- spin coupling and coupling constant, interpretation of NMR spectrum of simple organic compounds. **Mass Spectrometry:** Principle, theory and instrumentation of mass spectrometry, resolution of mass spectrometers, ionization techniques and mass analysers used in mass spectrometry, mass fragmentation and its rules, isotopic peaks. **Chromatography:** Principle, apparatus, instrumentation, chromatographic a) Paper chromatography b) Thin Layer	

chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography **Electrophoresis:** Principle, Instrumentation, Working conditions, actors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis) Iso-electric focusing. **Thermal Methods of Analysis:** Introduction, principle, instrumentation, sources of errors and application of DSC, DTA and TGA.	
Section B: Pharmaceutical Chemistry	**50**
Advanced Organic Chemistry: Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications. Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Debus-Radziszewski, imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine, Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement. Photochemical Reactions, Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. Pericyclic reactions Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions, optical activity, specific,rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L, notation, cis-trans isomerism, E and Z notation. **Advanced Medicinal Chemistry:** Prodrug design: Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents. Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters. **Chemistry of Natural Products:** Drugs Affecting the Central Nervous System: Morphine Alkaloids, Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol, Neuromuscular Blocking Drugs: Curare alkaloids, Anti-malarial drugs and Analogues, Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics	

(Cephalosporins and Carbapenem). General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male & female sex hormones, (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D). Terpenoids Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di(retinol, Phytol, taxol) and tri terpenoids (Squalene,Ginsenoside) carotinoids (β carotene). Vitamins Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.	
Section B: Pharmaceutics	**50**
Preformulations: Importance, objectives, physical properties and chemical properties characterization such as solubility, particle size, flow characterization, hydrolysis, oxidation, racemization etc. **Sustained and Controlled Release formulations**: Introduction & basic concepts, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation. **Gastro-Retentive Drug Delivery Systems**: Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. **Buccal Drug Delivery Systems**: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations. **Nano Particles & Liposomes**: Types, preparation and evaluation, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes **Micro Capsules:** Types, preparation and evaluation. **Pulmonary Drug Delivery Systems** : Aerosols, propellents, Containers, Types, preparation and evaluation, **Ocular Drug Delivery Systems**: Barriers of drug permeation, Methods to overcome barriers. requirement, formulation, methods of preparation, and evaluation of ophthalmic products. **Intra Nasal Route Delivery systems**; Types, preparation and evaluation. **Capsules:** Hard gelatin capsules, storage, filing, cleaning process general formulation contents and evaluation. Soft gelatin capsules, shell formulation, formulation contents, filing, sealing and storage. **Tablets:** Types, classification, granulation methods, general formulation, compression machines, different types of tooling's, difficulties in tableting, evaluation, sugar coating, compression coating, fil1m coating, problems in tablet coatings and their troubleshooting aspects.. **Parenterals- product requiring sterile packaging:** Definition, types advantages and limitations, general formulation, vehicles, production procedure, production facilities, controls, tests. **Suspensions and Emulsions:** Formulation, preparation and evaluation	

Biopharmaceutics: Mechanism of drug absorption, Factors affecting drug absorption- physic-chemical, physiological and biopharmaceutic factors. dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution. In vitro–in vivo correlation, dissolution profile comparisons, **Pharmacokinetics:** Basic considerations, pharmacokinetic models. **Bioavailability and Bioequivalence**: drug product performance, purpose of bioavailability studies, relative and absolute availability. methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, biopharmaceutics classification system	
Section B: Pharmacology	**50**
Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Significance of Protein binding. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors. **Neurotransmission:** General aspects and steps involved in neurotransmission. Neurohumoral transmission in autonomic nervous system (study about neurotransmitters - Noradrenaline and Acetylcholine). Neurohumoral transmission in central nervous system (study about neurotransmitters - histamine, serotonin, dopamine, GABA, and glutamate). **Chemotherapy:** Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Drugs used in Protozoal Infections Drugs used in the treatment of Helminthiasis Chemotherapy of cancer **Pharmacological and Toxicological Screening Methods:** Common laboratory animals, Bioassays, Anaesthesia, and euthanasia of experimental animals. Pre-clinical screening of antidepressants, anti-anxiety drugs, anti-psychotics, anti-epileptics, nootropics, anti-Parkinsonian drugs, analgesics, anti-inflammatory drugs, anti-pyretic drugs, anti-fertility agents, anti-ulcer, anti-emetic, anti-diarrhoeal and laxatives; anti-hypertensive, anti-anginal, anti-diabetics, anti-atherosclerotic, diuretics and anti-cancer drugs. Acute, sub-acute and chronic oral toxicity studies, acute eye irritation and dermal irritation studies, Ames test, micronucleus test, IND studies, safety pharmacology studies, alternative methods to animal toxicity testing **Cellular and Molecular Pharmacology** Gene expression and its regulation, siRNA and microRNA, gene mapping, gene sequencing; intrinsic and extrinsic pathways of apoptosis, necrosis, and autophagy. G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors. Secondary messengers: cyclic AMP, cyclic GMP, inositol 1,4,5-trisphosphate, NO, and diacylglycerol. MAPK signalling, JAK/STAT signalling pathway. DNA electrophoresis, PCR, ELISA and western blotting, Recombinant DNA technology.	

Section B: Pharmacognosy	50
Quality control of Drugs of Natural Origin: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, micrometers and camera lucida. **Extraction and Phytochemical Studies:** Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods of extraction including ultrasonic, microwave assisted & supercritical fluid extraction, method of fractionation. Detection and analysis of different classes of phytoconstituents by HPTLC, HPLC and Flash column chromatography. **Traditional System of Medicine & evaluation using animal models:** Different dosage forms of Indigenous System of Medicine. Screening of plant extracts/ phytochemicals for anti-diabetic, hepatoprotective, analgesic. anti-inflammatory, diuretic, anti-epileptic, anticancer, cardiovascular and antimicrobial activity through in vitro and in vivo models. **Pharmacognosy of selected drugs:** Senna, liquorice, digitalis, opium, cinchona, ergot, coriander, cumin, clove, fennel, arjuna, catechu, turmeric. tragacanth and ashwagandha **Plant tissue culture, Nutraceuticals, Marine natural products** **Herbal Drugs Development** Herbal sources for food supplements, Bioavailability enhancers, plant bitters & sweeteners, Herbal Cosmetics: Identification, collection and chemical nature of the natural products used in: Hair care, dandruff, dyeing, Skin care, anti-wrinkles & anti-aging, leucoderma, Scabies, Anticancer Herbal drugs**, Standardization of Herbal Drugs: Quantitative Pharmacognosy, Modern Instrumental** Techniques, Biological response measurements. **Recent Advancements in Novel Herbal Drug Delivery Systems** Phytosomes, Nanoparticles,Lipidic Nanoparticles, Liposomes and solid lipid nanoparticles, Microemulsions, Microspheres,Ethosome,Niosomes,Proniosomes, Dendrimer etc. **Current Status and Future Prospects of Novel Drug Delivery System in India** **Pharmacovigilance of drugs of natural origin**	