DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY,
UTTAR PRADESH, LUCKNOW

Syllabus

For

M.Pharm. (Drug Regulatory)

(Effective from the Session: 2016-17)

Course Structure and Evaluation Scheme for M. Pharm. Courses (All Subjects/ Specialization) (Effective from Session 2016-17)

DRUG REGULATORY

Semester-I

S.N.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
							Theory			Practical		
			L	T	P		CT	TA	ESE	TA	ESE	
1	*MPA101*	Modern Pharmaceutical Analytical Techniques	3	0	0	3	20	10	70	--	--	100
2	*MRA101/ MRA201*	Good Pharmaceutical Practices/ Documentation & Regulatory Writing	3	0	0	3	20	10	70	--	--	100
3	*MRA102/ MRA204*	Pharmaceutical Regulations in India/ Medical Devices Regulations	3	0	0	3	20	10	70	--	--	100
4	*MRA103*	International Pharmaceutical Regulations-I	3	0	0	3	20	10	70	--	--	100
5	*RPM101*	Research Process & Methodology	3	0	0	3	20	10	70	--	--	100
6	*MPA105*	Modern Pharmaceutical Analytical Techniques Practical	-	-	2	1	--	--	--	20	30	50
7	*MRA104*	Drug Regulatory Affairs Practical-I	-	-	3	2	--	--	--	20	30	50
Total						**18**						**600**

Semester-II

S.N.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
							Theory			Practical		
			L	T	P		CT	TA	ESE	TA	ESE	
1	*MRA201/ MRA101*	Documentation & Regulatory Writing/ Good Pharmaceutical Practices	3	0	0	3	20	10	70	--	--	100
2	*MRA202*	Biologics Regulations	3	0	0	3	20	10	70	--	--	100
3	*MRA203*	International Pharmaceutical Regulations-II	3	0	0	3	20	10	70	--	--	100
4	*MRA204/ MRA102*	Medical Devices Regulations/ Pharmaceutical Regulations in India	3	0	0	3	20	10	70	--	--	100
5	*MRA205*	Clinical Research Regulations	3	0	0	3	20	10	70	--	--	100
6	*MRA206*	Drug Regulatory Affairs Practical-II	-	-	2	1	--	--	--	20	30	50
7	*MRA207*	Seminar-I (Synopsis)	-	-	3	2	--	--	--	50	--	50
Total						**18**						**600**

Semester-III

S.N.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
							Theory			Practical		
			L	T	P		CT	TA	ESE	TA	ESE	
1	*MRA301*	Seminar-II	0	0	6	3	--	--	--	100	--	100
2	*MRA302*	Dissertation (Research Project Audit)	0	0	30	15	--	--	--	200	300	500
Total						**18**						**600**

Semester-IV

S.N.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
							Theory			Practical		
			L	T	P		CT	TA	ESE	TA	ESE	
1	*MRA401*	Dissertation (Final)	0	0	36	18	--	--	--	200	400	600
Total						**18**						**600**

M. Pharm. (Drug Regulatory)

First Semester

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (*MPA101*)

Unit-I

UV-Visible spectroscopy: Introduction, theory and laws associated with UV-visible spectroscopy, chromophores, auxochromes and their interaction with UV-Vis radiations, choice of solvents and solvent effect. Woodward- Fieser rule and applications of UV-visible spectroscopy.

IR Spectroscopy: Theory, modes of molecular vibrations, factors affecting vibrational frequencies and applications of IR spectroscopy. FT-IR. Interpretation of IR spectra of organic compounds.

Unit-II

Mass spectrometry: Different ionization methods (EI, CI, FAB, ESI, MALDI), analyzers of quadrupole and time of flight. Fragmentation patterns and its rules, relative abundance of ions, molecular ion peak, meta stable ions, isotopic peaks, Mc-Lafferty rearrangement, ring rule. Applications of mass spectrometry.

Flame emission spectroscopy and atomic absorption spectroscopy*:* Principle, interferences and applications of flame emission spectroscopy and atomic absorption spectroscopy.

Unit-III

NMR Spectroscopy: Principle, chemical shift, factors influencing chemical shift, spin-spin coupling, coupling constant, solvent requirement in NMR, NMR active compounds, free induction decay, relaxation process and NMR signals in various compounds. Applications of NMR spectroscopy.

Unit-IV

Chromatography: Principle, chromatographic parameters, factors affecting and applications of: Thin Layer chromatography, column chromatography, gas chromatography, affinity chromatography, ion exchange chromatography, size exclusion chromatography, high performance liquid chromatography, high performance thin layer chromatography.

Unit-V

Miscellaneous techniques:

Thermal methods of analysis: Introduction, principle, instrumentation and application of TGA, DTA and DSC.

Electron microscopy: Principle, instrumentation and applications of scanning electron microscopy (SEM), transmission electron, microscopy (TEM).

Radioimmuno assay: ELISA.

SUGGESTED BOOKS:

1. Pharmacopoeia of India, Ministry of Health, Govt. of India.
2. Skoog D.A., Holler F.J., Crouch S. R., Instrumental Analysis, Indian Edition, Brooks/Cole, Boston.
3. Willard H.H., Merrit L.L., Dean J.A., Settle P.A., Instrumental Methods of analysis, CBS Publishers and Distributors New Delhi.
4. Kemp W., Organic Spectroscopy, Palgrave, New York.
5. Becket A.H. and Stenlake J.B., Practical Pharmaceutical Chemistry Vol. I and II, The Athlone Press of the University of London.
6. Pavia D.L., Lampman G.M. and Kriz G.S., Introduction to Spectroscopy, Harcourt College Publishers, Philadelphia.
7. Kalsi P.S., Spectroscopy of Organic Compounds, New Age International Publishers, New Delhi.
8. Florey K., Analytical Profile of Drug Substance (All volume), Academic Press, Elsevier, Massachusetts.

9. Chatten L.G., A Text Book of Pharmaceutical Chemistry, Vol. I and II, Marcel Dekker, New York.
10. Silverstein R.M., Spectrometric Identification of Organic compounds, John Wiley & Sons, New Jersey.
11. Obonson J.W.R., Undergraduate Instrumental Analysis, Marcel Dekker Inc, New York.
12. Parikh V.H., Absorption Spectroscopy of Organic Molecules, Addison-Wesley Publishing Co., London.
13. Stahl E., Thin Layer Chromatography: A Laboratory Handbook, Springer, Berlin.

GOOD PHARMACEUTICAL PRACTICES (*MRA101/MRA201*)

Unit-I

Current good manufacturing practices: Introduction, US cGMP Part 210 and Part 211, EC principles of GMP (Directive 91/356/EEC) Article 6 to 14, WHO cGMP guidelines for GAMP-5 and medical devices.

Unit-II

Good laboratory practices: Introduction, USFDA-GLP regulations (subpart A to K), GLP inspection process, GLP documentation, audit, goals of laboratory quality audit, audit tools, ISO/IEC 17025.

Unit-III

Good automated laboratory practices: Introduction to GALP, principles of GALP, GALP requirements, SOPs of GALP, training, documentation, 21 CFR Part 11, software evaluation checklist, ISO 9001.

Unit-IV

Good distribution practices: Introduction to GDP, principles, personnel, documentation, premises and equipment, returns, self inspection, provision of information, stability testing principles, WHO GDP, USP GDP (supply chain integrity).

Unit-V

Quality management systems: Concept of quality, total quality management, quality by design, six sigma concept, change control. Validation: Types of validation, validation master plan (VMP), analytical method validation. Validation of utilities (water systems, heat, ventilation and air conditioning (HVAC)), cleaning validation. ICH guidelines to establish quality, safety and efficacy of drug substances and products.

SUGGESTED BOOKS:

1. Weinberg S., Good Laboratory Practice Regulations, Drugs and the Pharmaceutical Sciences, Vol.168, .
2. Sharp J., Good Pharmaceutical Manufacturing practice, Rational and compliance, CRC Press, Florida.
3. Bleisner D.M., Establishing a cGMP Laboratory Audit System: A Practical Guide, Wiley Publication, New Jersey.
4. Sharma P.P., How to Practice GLP, Vandana Publications, Agra.
5. Singer D.C., Laboratory Auditing for Quality and Regulatory compliance, Drugs and the Pharmaceutical Sciences, Vol.150,.

PHARMACEUTICAL REGULATIONS IN INDIA (*MRA102/MRA204*)

Unit-I

Relevant provisions of acts and rules (with latest amendments): Drugs and Cosmetics Act 1940 and other relevant provisions (Rules, Schedules and Guidelines), Rules 1945: DPCO and NPPA, Import of drugs, Manufacture of drugs, Sale of Drugs, Packing of drugs.

Central drug standard control organization and state licensing authority: Rules, regulations, guidelines for regulatory filing of document to relevant regulations**,** format and contents of regulatory dossier filing**,** clinical trials for new drugs, medical devices and fixed dose combinations.

Unit-II

Indian Pharmacopoeial standards, BIS standards and ISO standards.

Unit-III

Bioavailability and bioequivalence: BCS Classification of drugs, bioavailability and bioequivalence data, regulatory requirements for bioequivalence study, stability requirements as per ICH and WHO.

Unit-IV

Guidelines for drug testing in animals: Rationale for conducting studies, CPCSEA guidelines, ethical guidelines for human participants, ICMR-DBT guidelines for stem cell research.

Unit-V

Intellectual property rights: Patent, trademark, copyright, industrial designs and geographical indications, Indian patent scenario.

SUGGESTED BOOKS:

1. Manual of Patent Practice and Procedure, The Patent Office of India.
2. Bessen J., Meurer M.J., Patent Failure How Judges, Bureaucrats, and Lawyers Put Innovators at Risk, .
3. Chin R., Lee B.Y., Principles and Practice of Clinical Trial Medicine, .
4. Ethical Guidelines for Biomedical Research on Human Participants, Indian Council of Medical Research, New Delhi.
5. CPCSEA Guidelines for Laboratory Animal Facility by Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA).
6. ICH E6 Guideline: Good Clinical Practice, ICH Harmonized Tripartite.
7. Guidance for Industry on Submission of Clinical Trial Application for Evaluating Safety and Efficacy, CDSCO (Central Drug Standard Control Organization).
8. Guidance for Industry on Requirement of Chemical and Pharmaceutical Information Iincluding Stability Study Data before Approval of Clinical Trials/ BE studies, CDSCO.
9. Guidelines for Import and Manufacture of Medical Devices by CDSCO.
10. Guidelines from Official Website of CDSCO.

INTERNATIONAL PHARMACEUTICAL REGULATIONS-I (*MRA103*)

Unit-I

Regulatory aspects in USA: Organization structure and functions of USFDA, federal register and code of federal regulations (CFR), orange book, purple book, drug master files (DMF) system in US. Regulatory approval process for investigational new drug (IND), new drug application (NDA), abbreviated new drug application (ANDA), supplemental new drug application (SNDA). Regulatory requirements for orphan drugs and combination products. Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in USA.

Unit-II

Regulatory aspects in European Union: Organization and structure of EMA and EDQM, general guidelines of EMA, active substance master files (ASMF) system in EU, content and approval process of IMPD, marketing authorization procedures in EU (Centralized procedure, decentralized procedure, mutual recognition procedure and national procedure), regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in EU, compliance of European Pharmacopoeia (CEP) and certificate of suitability (CoS), marketing authorization (MA) transfers, qualified person (QP) in EU.

Unit-III

Regulatory aspects in Japan: Organization of the PMDA, pharmaceutical laws and regulations, types of registration applications, DMF system in Japan, drug regulatory approval process. Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in Japan, post marketing surveillance in Japan.

Unit-IV

Regulatory aspects in Brazil: Organization of the PMDA, pharmaceutical laws and regulations, types of registration applications, DMF system in Brazil, drug regulatory approval process. Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals in Brazil, post marketing surveillance in Brazil.

Unit-V

Regulatory aspects in South Asia: Pharmaceutical laws and regulations, types of registration applications, DMF system, drug regulatory approval process. Regulatory considerations for manufacturing, packaging and labeling of pharmaceuticals, post marketing surveillance.

SUGGESTED BOOKS:

1. Berry I.R., Martin R.P., the Pharmaceutical Regulatory Process. Drugs and the Pharmaceutical Sciences, Vol. 185, Informa Healthcare Publishers, London.
2. Guarino R.A., New Drug Approval Process: Accelerating Global Registrations, MD, Drugs and the Pharmaceutical Sciences, Vol.190.
3. Sandy Weinberg, Guidebook for drug regulatory submissions, John Wiley and Sons. Inc., New Jersey.
4. Rick N. G., Drugs: From Discovery to Approval.
5. Mathieu M., New Drug Development: A Regulatory Overview.
6. Fetterman J. E., Pines W. L., Slatko G. H., Pharmaceutical Risk Management.
7. Sietsema W.K., Preparation and Maintenance of the IND Application in eCTD Format.
8. Country Specific Guidelines from Official Websites.

RESEARCH PROCESS & METHODOLOGY (*RPM101*)

Unit-I

Fundamentals of research: Meaning, objective and importance of research methodology, types of research (basic, applied and patent oriented), defining research problem, research design including various methods, research process and steps involved. Literature survey and documentation.

Unit-II

Data collection, analysis and hypothesis testing: Classification of data, methods of data collection, sample size, sampling procedure and methods. Data processing and graphical representation of data. Statistical inference and hypothesis: Types of hypothesis (experimental and non-experimental), hypothesis testing (Parametric and non-parametric tests), generalization and interpretation of results. Use of statistical softwares/ packages in data analysis (SPSS, Graph Pad Prism).

Unit-III

Multivariate analysis: Introduction to multivariate analysis (Linear and non linear methods) and their validation methods (Statistical parameters).

Research ethics, plagiarism and impact of research: Research ethics, responsibility and accountability of the researchers, ethical consideration during animal experimentation including CPCSEA guidelines. Plagiarism and use of plagiarism detection softwares such as-VIPER. Impact of research on environment and society, commercialization of research, intellectual ownership.

Unit-IV

Technical writing and reporting of research: Types of research report: Dissertation and thesis, research paper, review article, short communication, conference presentation, meeting report etc. Structure and organization of research reports: Title, abstract, key words, introduction, methodology, results, discussion, conclusion, acknowledgement, references, footnotes, tables and illustrations. Impact factor, rating, indexing and citation of journals. Detailed study of 'Instruction to Authors' of any research journal, a thorough understanding of steps involved in submitting articles electronically to any research journal (Registration, new article submission, tracking process, submitting revised articles).

Unit-V

Funding agencies and research grants: Introduction to various research funding agencies such as-DST, DBT, AICTE, UGC, CSIR, ICMR, AAYUSH, and DRDO along with their function in India. Writing a research project and procurement of research grant. Project cost analysis.

SUGGESTED BOOKS:

1. Kothari C.R., Research Methodology Methods and Techniques, Wishwa Prakashan, New Delhi.
2. Lokesh K., Methodology of Educational research, Vikash Publishing House Pvt. Ltd., New Delhi.
3. Kumar R., Research Methodology, Dorling Kindersley (India) Pvt. Ltd., New Delhi.
4. Rao G.N., Research Methodology and Qualitative Methods, B.S. Publications, Hyderabad.
5. Saunders M., Lewis P. and Thornhill A., Research Methods for Business Students, Dorling Kindersley (India) Pvt. Ltd., New Delhi.
6. Bolton S. and Bon C., Pharmaceutical Statistics: Practical and Clinical Applications, Marcel Dekker, New York.
7. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, An introduction to Research Methodology, RBSA Publishers, Jaipur.
8. Fisher R.A. Statistical Methods for Research Works, Oliver and Boyd, Edinburgh.
9. Chow S.S. and Liu J.P., Statistical Design and Analysis in Pharmaceutical Sciences, Marcel Dekker, New York.
10. Buncher C.R., Statistics in the Pharmaceutical Industry, Marcel Dekker, New York.

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES PRACTICAL (*MPA105*)

1. Determination of the wavelength of maximum absorbance (λ max) of given compounds by UV-Visible spectrophotometry.
2. Quantitative estimation of Pharmacopoeial compounds by UV-Visible spectrophotometry.
3. UV-Vis spectrophotometric assay of pharmaceutical formulations containing Pharmacopoeial compounds as active ingredients.
4. Simultaneous estimation of multi component containing formulations by UV-Visible spectrophotometry.
5. Quantitative estimation of caffeine in beverages using UV-Vis spectrophotometer.
6. Study and interpretation of the FT-IR/IR spectra of given compounds.
7. Separation of the organic compounds from given mixture by thin layer chromatography (TLC).
8. Isolation of the organic compounds from given mixture by two-dimensional thin layer chromatography (2D-TLC).
9. Separation and quantitative estimation of organic compounds in the given mixture by thin layer chromatography (Preparative TLC).
10. Column packing and separation of organic compounds with the help of column chromatography.
11. Simultaneous estimation of any marketed formulation using RP-HPLC method.
12. Stability studies of marketed formulation by RP-HPLC method as per ICH guidelines.
13. Estimation of Sodium/ Potassium by flame photometry.

DRUG REGULATORY AFFAIRS PRACTICAL-I (*MRA104*)

The practicals may be chosen from the following suggested list of experiments based on the subjects opted in that particular semester-

1. Case studies (4 Nos.) of each of good pharmaceutical practices.
2. Documentation for in process and finished products quality control tests for solid, liquid, semisolid and sterile preparations.
3. Preparation of SOPs, analytical reports (Stability and validation).
4. Protocol preparation for documentation of various types of records (BMR, MFR, DR)
5. Labeling comparison between brand and generics.
6. Preparation of clinical trial protocol for registering trial in India.
7. Registration for conducting BA/ BE studies in India.
8. Import of drugs for research and developmental activities.
9. Preparation of regulatory dossier as per Indian CTD format.
10. Registering for different intellectual property rights in India.
11. GMP Audit requirements as per CDSCO.
12. Preparation and documentation for Indian patent application.
13. Preparation of checklist for registration of IND as per ICH CTD format.
14. Preparation of checklist for registration of NDA as per ICH CTD format.
15. Preparation of checklist for registration of ANDA as per ICH CTD format.
16. Case studies on response with scientific rationale to USFDA warning letter.
17. Preparation of submission checklist of IMPD for EU submission.
18. Comparison study of marketing authorization procedures in EU.
19. Comparative study of DMF system in US, EU and Japan.
20. Preparation of regulatory submission using eCTD software.
21. Preparation of clinical trial application (CTA) for US submission.
22. Preparation of clinical trial application (CTA) for EU submission.
23. Comparison o f clinical trial application requirements of US, EU and Japan of a dosage form.
24. Regulatory requirements checklist for conducting clinical trials in India.
25. Regulatory requirements checklist for conducting clinical trials in Europe.

26. Regulatory requirements checklist for conducting clinical trials in USA.
27. Case studies on: Change management/change control, deviations; Corrective and preventive actions (CAPA).
28. Documentation of raw materials analysis as per official monographs.
29. Preparation of audit checklist for various agencies.
30. Preparation of submission to FDA using eCTD software.
31. Preparation of submission to EMA using eCTD software.
32. Preparation of submission to MHRA using eCTD software.
33. Preparation of biologics license applications (BLA).
34. Preparation of documents required for vaccine product approval.
35. Comparison of clinical trial application requirements of US, EU and India of biologics.
36. Preparation of checklist for registration of blood and blood products.
37. Registration requirement comparison study in 5 emerging markets (WHO) and preparing check list for market authorization.
38. Registration requirement comparison study in emerging markets (BRICS) and preparing check list for market authorization.
39. Registration requirement comparison study in emerging markets (GCC) and preparing check list for market authorization.
40. Checklists for 510k and PMA for US market.
41. Checklist for CE marking for various classes of devices for EU.
42. STED Application for class III devices.
43. Audit checklist for medical device facility.
44. Clinical investigation plan for medical devices.

Second Semester

DOCUMENTATION AND REGULATORY WRITING (*MRA201/MRA101*)

Unit-I

Documentation in pharmaceutical industry: Exploratory product development brief (EPDB) for drug substance and drug product, product development plan (PDP), product development report (PDR), standard operating procedures(SOP),master formula record, batch manufacturing record and its calculations, batch reconciliation, batch packaging records, print pack specifications, distribution records, certificate of analysis (CoA), site master file and drug master files (DMF).

Unit-II

Dossier preparation and submission: Introduction and overview of dossiers, contents and organization of dossier, binders and sections, compilation and review of dossier. Paper submissions, overview and modules of CTD.

Electronic submission: Planning electronic submission, requirements for submission, regulatory bindings and requirements, tool and technologies, electronic dossier submission process and validating the submission, electronic submission gateway (ESG). Non eCTD electronic submissions (NeeS), Asian CTD formats (ACTD) submission. Organizing, process and validation of submission.

Unit-III

Audits: Introduction, definition, summary, types of audits, GMP compliance audit, audit policy, internal and external audits, second party audits, external third party audits, auditing strategies, preparation and conducting audit, auditing strategies, audit analysis, audit report, audit follow up auditing/ inspection of manufacturing facilities by regulatory agencies, timelines for audits/inspection

Unit-IV

Inspections: Pre-approval inspections, inspection of pharmaceutical manufacturers, inspection of drug distribution channels, quality systems requirements for national good manufacturing practice inspectorates, inspection report, model certificate of good manufacturing practices, root cause analysis, corrective and preventive action (CAPA)

Unit-V

Product life cycle management: Prior approval supplement (PAS), post approval changes (SUPAC), changes being effected in 30 Days (CBE-30), annual report, post marketing, reporting requirements, post approval labeling changes, lifecycle management, fda inspection and enforcement, establishment inspection report (EIR), warning letters, recalls, seizure and injunctions.

SUGGESTED BOOKS:

1. Ginsbury K. and Bismuth G., Compliance auditing for Pharmaceutical Manufacturers. Interpharm, CRC Press, Florida.
2. Gad S.C., Pharmaceutical Manufacturing Handbook, Regulations and Quality, Wiley Interscience, New Jersey.
3. Baird, R.M., Hodges, N.A., Denyar S.P., Handbook of Microbiological Quality Control. CRC Press, Florida.
4. Singer D.C., Stefan R.L., Staden J.F.V., Laboratory Auditing for Quality and Regulatory Compliance, Taylor and Francis, New York.
5. Endres A., Implementing Juran's Road Map for Quality Leadership: Benchmarks and Results, Wiley, New Jersey.
6. Antony J., Preece D., Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, Routledge, Abingdon-on-Thames.
7. Lawler E.E., Mohrman S.A., Benson G., Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000: The CEO Report. Jossey-Bass, New Jersey.

8. Fairfield J.W., Corporate Culture and the Quality Organization, Quorum Books, Connecticut.
9. Avery C., Zabel D., The Quality Management Sourcebook: An International Guide to Materials and Resource, Routledge, Abingdon-on-Thames.
10. Tague N.R., The Quality Toolbox, ASQ Publications, Milwaukee WI53203.
11. Juran J.M., De Feo J.A., Juran's Quality Handbook, ASQ Publications, Milwaukee.
12. Okes D., Root Cause Analysis, The Core of Problem Solving and Corrective Action, ASQ Publications, Milwaukee WI53203.

BIOLOGICS REGULATIONS (*MRA202*)

Unit-I

India: Introduction, applicable regulations and guidelines, principles for development of similar biologics, data requirements for preclinical studies, data requirements for clinical trial application, data requirements for market authorization application, post-market data for similar biologics.

Unit-II

USA: Introduction to biologics; biologics, biological and biosimilars, different biological products, difference between generic drug and biosimilars, laws, regulations , development and approval of biologics and biosimilars (IND, PMA, BLA, NDA, 510(k), pre-clinical and clinical development considerations, advertising, labeling and packing of biologics

Unit III

European Union: Introduction to biologics- Directives, scientific guidelines and guidance related to biologics in EU, comparability/ biosimilarity assessment, plasma master file, TSE/ BSE evaluation, development and regulatory approval of biologics (Investigational medicinal products and biosimilars). Pre-clinical and clinical development considerations- Advertising, labeling and packing of biologics in EU

Unit IV

Vaccine regulations in India, US and European Union: Clinical evaluation, marketing authorization, registration or licensing, quality assessment, pharmacovigilance.

Unit V

Blood and blood products regulations in India: Regulatory requirements of blood and/or its components including blood products, label requirements, ISBT (International Society of Blood Transfusion) and IHN (International Haemovigilence Network)

SUGGESTED BOOKS:

1. Pisano D.J., Mantus D.S., FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics, Informa Healthcare.
2. Singh M., Wang W., Biological Drug Products: Development and Strategies, Wiley, New Jersey.
3. Singh M., Srivastava I.K., Development of Vaccines: From Discovery to Clinical Testing, Wiley, New Jersey.
4. Guidelines on Similar Biologics: Regulatory Requirements for Marketing Authorization in India.
5. www.fda.gov/biologicsbloodVaccines/GuidanceComplianceRegulatoryInformation(Biologics)
6. www.fda.gov/BiologicsBloodVaccines/GuidanceComplianceRegulatoryInformation/
7. www.who.int/biologicals/en
8. www.ema.europa.eu ›scientific guidelines/biological
9. www.ihn-org.com
10. www.isbtweb.org
11. www.cdsco.nic.in

INTERNATIONAL PHARMACEUTICAL REGULATIONS-II (*MRA203*)

Unit-I

Emerging Market: Introduction, countries covered, study of the world map, study of various committees across the globe (ASEAN, APEC, EAC, GCC, PANDRH, SADC).

Unit-II

WHO: WHO-GMP, regulatory requirements for registration of drugs and post approval requirements in WHO through prequalification program, certificate of pharmaceutical product (CoPP)- General and country specific (South Africa, Nigeria, Kenya and Botswana)

Unit-III

ASIAN Countries: Introduction to ACTD, regulatory requirements for registration of drugs and post approval requirements in China and South Korea and Association of Southeast Asian Nations (ASEAN) region i.e. Malaysia, Singapore.

Unit-IV

Commonwealth Independent States (CIS): Regulatory pre-requisites related to marketing authorization requirements for drugs and post approval requirements in CIS countries i.e. Russia, Kazakhstan and Ukraine.

Unit-V

Gulf Cooperation Council (GCC) for Arab States: Regulatory pre-requisites related to Marketing authorization requirements for drugs and post approval requirements in Saudi Arabia and UAE

SUGGESTED BOOKS:

1. http://www.who.int/medicines/areas/quality_safety/regulation_legislation/ListMRAWebsites.pdf
2. Hew D., Roadmap to an ASEAN Economic Community, ISEAS Publications, Singapore.
3. Kobayashi-Hillary M., Building a Future with BRICS: The Next Decade for Offshoring, Springer, New York.
4. Kobayashi-Hillary M., Outsourcing to India: The Offshore Advantage- Trade performance and Regional Integration of the CIS Countries, Springer, New York.
5. Frienkman L., The World Bank, Washington DC.
6. Abbott F.M., Dukes G., Dukes M.N.G., Global Pharmaceutical Policy: Ensuring Medicines for Tomorrow's World, Cheltenham.

MEDICAL DEVICES REGULATIONS (*MRA204*)

Unit-I

Medical devices: Introduction, differentiating medical devices from IVDs and combination products, product lifecycle of medical devices, classification of medical devices.ISO13485, schedule MIII.
IMDRF/GHTF: Introduction, organizational structure, purpose and functions, regulatory guidelines, working groups, summary technical document (STED), global medical device nomenclature (GMDN).

Unit-II

Ethics: Clinical investigation of medical devices, clinical investigation plan for medical devices, good clinical practice for clinical investigation of medical devices (ISO 14155:2011) **Quality:** Quality system regulations of medical devices: ISO 13485, quality risk.
Management of medical devices: ISO 14971, Validation and verification of medical device, adverse event reporting of medical device

Unit-III

USA: Introduction, classification, regulatory approval process for medical devices (510k) premarket notification, pre-market approval (PMA), investigational device exemption (IDE) and *in-vitro* diagnostics, quality system requirements 21 CFR Part 820, labeling requirements 21 CFR Part 801, post marketing surveillance of MD and unique device identification (UDI).

Unit-IV

European Union: Introduction, classification, regulatory approval process for medical devices (medical device directive, active implantable medical device directive) and *in-vitro* diagnostics (*in-vitro* diagnostics directive), certification process.
Basics of *in-vitro* diagnostics, classification and approval process.

Unit-V

Medical device regulations in world health organization (WHO): Registration procedures, quality system requirements and regulatory requirements.
Asia: Clinical trial regulations specific for medical devices, registration procedures, quality system requirements and regulatory requirements for Japan, India and China.

SUGGESTED BOOKS:

1. Pisano D.J., Mantus D., FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics, CRC Press, Florida.
2. Kahan J.S., Medical Device Development: A Regulatory Overview, Hogan and Hartson LLP, Washington DC.
3. Kahan J.S., Medical Device Development: A Regulatory Overview, Hogan and Lovells LLP, Washington DC.
4. Medina C., Compliance Handbook for Pharmaceuticals, Medical Devices and Biologics.
5. Country Specific Guidelines from Official Websites.

CLINICAL RESEARCH REGULATIONS (*MRA205*)

Unit-I

Basics for clinical trials for drug development process: Clinical trial protocol, detailed study of phases of clinical trials, ethical principles governing informed consent process, patient information sheet and informed consent form, the informed consent process and documentation.

Unit-II

Basic CT for MD ethics in clinical research: Good clinical practice (ICH-GCP) guidelines, The ethics of randomized clinical trials, the role of placebo in clinical trials, institutional review board/ independent ethics committee/ ethics committee (composition, roles, responsibilities, review and approval process and ongoing monitoring of safety data), data safety monitoring boards, responsibilities of sponsor, CRO and investigator in ethical conduct of clinical research.

Unit-III

Regulations governing clinical trials: Regulations to conduct clinical trial studies in USA, FDA Guidance for industry for acceptance of foreign clinical studies, FDA clinical trials guidance document, clinical research regulations in European Union, clinical research regulations in India (Schedule Y).

Unit-IV

Clinical research related guidelines: Good clinical practice guidelines (ICH GCP E6), Indian GCP guidelines, ICMR ethical guidelines for biomedical research, CDSCO guidelines.

ICH Guidance's

E4: Dose response information to support drug registration.
E7: Studies in support of general population- Geriatrics.
E8: General considerations of clinical trials.
E10: Choice of control groups and related issues in clinical trials.
E 11: Clinical investigation of medicinal products in the pediatric population.

Unit-V

USA and EU Guidance:

CFR 21Part 50: Protection of human subjects.
CFR 21Part 54: Financial disclosure by clinical investigators.
CFR 21Part 312: IND Application.
CFR 21Part 314: Application for FDA approval to market a new drug.
CFR 21Part 320: Bioavailability and bioequivalence requirements.
CFR 21Part 812: Investigational device exemptions.
CFR 21Part 822: Post-market surveillance.
FDA Safety reporting requirements for INDs and BA/BE studies, FDA med watch.

European Union: EMA Guidance

EU Directives 2001, scientific guidelines for medicinal products for human use, Pharmacovigilance for medicinal products for human use.

SUGGESTED BOOKS:

1. Rozovsky F.A., Adams R.K., Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance, Jossey-Bass, New York.
2. Barnes M., Kulynych J., HIPAA and Human Subjects Research: A Question and Answer Reference Guide, Barnett International, Needham NA02494.
3. Gallin J.I. and Ognibene F.P., Principles and Practices of Clinical Research, Academic Press, Cambridge.
4. Speers, M.A., Karlberg, J.P.E., Reviewing Clinical Trials: A Guide for the Ethics Committee, Harvard University Press, Boston.

5. Cartwright A.C., International Pharmaceutical Product Registration: Aspects of Quality, Safety and Efficacy, Taylor and Francis Inc., New York.
6. Guarino, R.A.,New Drug Approval Process: The Global Challenge, Marcel Dekker Inc., New York.
7. Pisano D.J., David Mantus, FDA regulatory affairs: A Guide for Prescription Drugs, Medical Devices and Biologics, CRC Press, Florida.
8. Country Specific Guidelines from Official Websites.

DRUG REGULATORY AFFAIRS PRACTICAL-II (*MRA206*)

The practicals may be chosen from the following suggested list of experiments based on the subjects opted in that particular semester-

1. Case studies (4 Nos.) of each of good pharmaceutical practices.
2. Documentation for in process and finished products quality control tests for solid, liquid, semisolid and sterile preparations.
3. Preparation of SOPs, analytical reports (Stability and validation).
4. Protocol preparation for documentation of various types of records (BMR, MFR, DR)
5. Labeling comparison between brand and generics.
6. Preparation of clinical trial protocol for registering trial in India.
7. Registration for conducting BA/ BE studies in India.
8. Import of drugs for research and developmental activities.
9. Preparation of regulatory dossier as per Indian CTD format.
10. Registering for different intellectual property rights in India.
11. GMP Audit requirements as per CDSCO.
12. Preparation and documentation for Indian patent application.
13. Preparation of checklist for registration of IND as per ICH CTD format.
14. Preparation of checklist for registration of NDA as per ICH CTD format.
15. Preparation of checklist for registration of ANDA as per ICH CTD format.
16. Case studies on response with scientific rationale to USFDA warning letter.
17. Preparation of submission checklist of IMPD for EU submission.
18. Comparison study of marketing authorization procedures in EU.
19. Comparative study of DMF system in US, EU and Japan.
20. Preparation of regulatory submission using eCTD software.
21. Preparation of clinical trial application (CTA) for US submission.
22. Preparation of clinical trial application (CTA) for EU submission.
23. Comparison o f clinical trial application requirements of US, EU and Japan of a dosage form.
24. Regulatory requirements checklist for conducting clinical trials in India.
25. Regulatory requirements checklist for conducting clinical trials in Europe.
26. Regulatory requirements checklist for conducting clinical trials in USA.
27. Case studies on: Change management/change control, deviations; Corrective and preventive actions (CAPA).
28. Documentation of raw materials analysis as per official monographs.
29. Preparation of audit checklist for various agencies.
30. Preparation of submission to FDA using eCTD software.
31. Preparation of submission to EMA using eCTD software.
32. Preparation of submission to MHRA using eCTD software.
33. Preparation of biologics license applications (BLA).
34. Preparation of documents required for vaccine product approval.
35. Comparison of clinical trial application requirements of US, EU and India of biologics.
36. Preparation of checklist for registration of blood and blood products.

37. Registration requirement comparison study in 5 emerging markets (WHO) and preparing check list for market authorization.
38. Registration requirement comparison study in emerging markets (BRICS) and preparing check list for market authorization.
39. Registration requirement comparison study in emerging markets (GCC) and preparing check list for market authorization.
40. Checklists for 510k and PMA for US market.
41. Checklist for CE marking for various classes of devices for EU.
42. STED Application for class III devices.
43. Audit checklist for medical device facility.
44. Clinical investigation plan for medical devices.

SEMINAR-I (SYNOPSIS) (*MRA206*)