

# **SAURASHTRA UNIVERSITY**

## **RAJKOT**

(ACCREDITED GRADE "A" BY NAAC)



### **FACULTY OF PHARMACY**

Syllabus for

**M. Pharm.**

**(PHARMACEUTICAL QUALITY ASSURANCE)**

Choice Based Credit System

**With Effect From: 2017-18**

# **PROGRAM OUTCOMES**

## **POs OF M. PHARM**

### **(PHARMACEUTICAL QUALITY ASSURANCE)**

Students of all post undergraduate pharmacy degree programs at the time of graduation will be able to learn:

#### **PO 1: Research and development**

The students will be able to generate ideas for research, analyse them, execute them and publish the findings.

#### **PO 2: Domain knowledge:**

Students will be able to acquire knowledge and comprehension of the core and specialization subjects of the respective pharmacy specialization.

#### **PO 3: Communication skills:**

Students will be able to learn communication by giving seminars, journal club and other organizational activities. They will be able to comprehend and write effective reports, make effective presentations and documentation.

#### **PO 4: Planning skills:**

Students will be able to demonstrate effective planning abilities including time management, resource management, and organizational skills. They will be able to develop and implement plans and organize work to meet deadlines.

#### **PO 5: Problem analysis:**

Students will be able to develop, critical thinking and analytical skills while solving problems and making decisions in dissertation research.

#### **PO 6: Usage of contemporary research tools and techniques:**

Students will be able to learn, select, and apply appropriate current methods and procedures in modern pharmaceutical research with an understanding of the limitations.

#### **PO 7: Social responsibilities:**

Students will be able to understand, analyze and communicate the value of their professional roles in society (e.g. as health care professionals, promoters of health, educators, managers, employers, employees).

#### **PO 8: Continuous learning:**

They will be able to recognize the need for continuous up gradation of their knowledge and skills

## **Program Specific Outcomes PSOs OF M. PHARM (PHARMACEUTICAL QUALITY ASSURANCE)**

The following program specific outcomes for Master of Pharmacy Program at various specializations have been structured based on outputs and opinion from various stakeholders who are relevant to this program.

- PS O1:** Learn Quality Assurance, Total Quality Management, and Quality Management concepts.
- PS O2:** Learn about GMP, Schedule M, ISO 9000 and 14000 standards, NABL accreditation.
- PS O3:** Learn ICH, USFDA, WHO and other regulatory guidelines and common requirement for product registration.
- PS O4:** Learn the different quality concept like GLP, GCP, QbD, PAT and their documentation.
- PS O5:** Learn various pharmaceutical product development affairs such as calibration, validation, product complain and recall, pharmacovigilance, corrective and preventive action, documentation and their regulatory requirement.
- PS O6:** To deal with various advanced instrumental techniques for identification, characterization, and quantification of drugs and pharmaceuticals.
- PS O7:** To know the science of detection of impurities, impurities in pharmaceutical formulations, impurity profiling, stability testing of drugs and phytopharmaceuticals, and their protocol development.
- PS O8:** To understand validation and its application in industry, their methodologies and application in manufacturing processes.
- PS O9:** To create a knowledge with various hyphenated analytical instrumental techniques for identification, characterization, and quantification of drugs.
- PS 10:** To impart knowledge about extraction, separation of drugs from biological samples using different techniques and guidelines for analytical methods.
- PS 11:** To create a talent pool by involving students in research projects and to make students undertake research projects under faculty guidance for publication.
- PSO12:** To foster ambitious desire among students to undertake higher studies and career growth.

**DEPARTMENT OF PHARMACEUTICAL SCIENCES**  
**Course Structure and Scheme of Examination**  
**(with effective from June -2017)**

**Semester I**

Subject code	Title of the course	Course credit	No. of Hrs. per week	Weightage for Internal Examination	Weightage for External Examination	Total Marks	Duration of Semester end Exam in Hrs.
MQA 101T	Modern pharmaceutical analytical techniques	4	4	25	75	100	3
MQA 102T	Quality management systems	4	4	25	75	100	3
MQA 103T	Quality control and quality assurance	4	4	25	75	100	3
MQA 104T	Product development and technology transfer	4	4	25	75	100	3
MQA 105P	Quality Assurance Practical – I Practicals	6	12	50	100	150	6
-	Seminar/Assignment	4	7	-	-	100	-
<b>Total</b>		<b>26</b>				<b>650</b>	

## Semester II

Subject code	Title of the course	Course credit	No. of Hrs. per week	Weightage for Internal Examination	Weightage for External Examination	Total Marks	Duration of Semester end Exam in Hrs.
<b>MQA 201T</b>	Hazards and Safety Management	4	4	25	75	100	3
<b>MQA 202T</b>	Pharmaceutical Validation	4	4	25	75	100	3
<b>MQA 203T</b>	Audits and Regulatory Compliance	4	4	25	75	100	3
<b>MQA 204T</b>	Pharmaceutical Manufacturing Technology	4	4	25	75	100	3
<b>MQA 205P</b>	Quality Assurance Practical – II Practicals	6	12	50	100	150	6
-	Seminar/Assignment	4	7	-	-	100	-
<b>Total</b>		<b>26</b>				<b>650</b>	

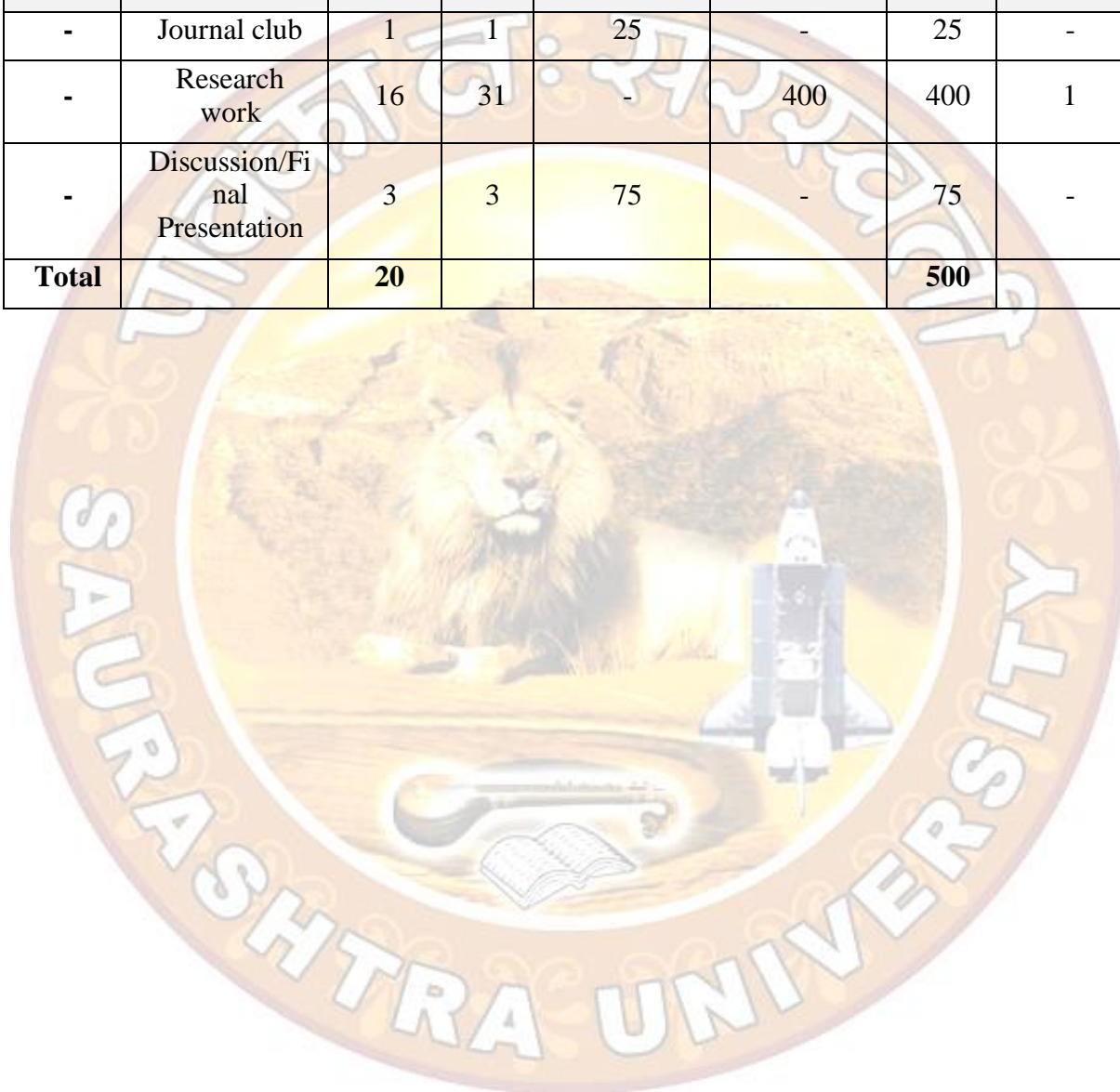
### Semester III

Subject code	Title of the course	Course credit	No. of Hrs. per week	Weightage for Internal Examination	Weightage for External Examination	Total Marks	Duration of Semester end Exam in Hrs.
<b>MRM 301T</b>	Research Methodology and Biostatistics*	4	4	25	75	100	3
-	Journal club	1	1	25	-	25	-
-	Discussion / Presentation (Proposal Presentation)	2	2	50	-	50	-
-	Research Work	14	28	-	350	350	1
<b>Total</b>		<b>21</b>				<b>525</b>	



## Semester IV

Subject code	Title of the course	Course credit	No. of Hrs . per week	Weightage for Internal Examination	Weightage for External Examination	Total Marks	Duration of Semester end Exam in Hrs.
-	Journal club	1	1	25	-	25	-
-	Research work	16	31	-	400	400	1
-	Discussion/Final Presentation	3	3	75	-	75	-
<b>Total</b>		<b>20</b>				<b>500</b>	



**M. PHARM SEMESTER I**  
**Modern Pharmaceutical Analytical Techniques (MQA 101T)**  
**Theory: 4 Hrs. /Week**

**Scope**

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

**Objectives**

After completion of course student is able to know about,

Chemicals and Excipients

The analysis of various drugs in single and combination dosage forms

Theoretical and practical skills of the instruments

**Course Outcomes**

**CO.1:** The subject will teach graduates advanced analytical techniques like NMR, Mass spectrometer, IR, HPLC, HPTLC etc. which can help them in their professional carrier.

**CO.2:** This will learn student's theoretical practical skills of the instruments and even the qualitative and quantitative parameters of the drug.

**Course content**

**Unit 1**

**10 Hrs**

- a) **UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy.
- b) **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy
- c) **Spectrofluorimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.
- d) **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications.

**Unit 2**

**10 Hrs**

NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and <sup>13</sup>C NMR. Applications of NMR spectroscopy.

**Unit 3**

**10 Hrs**

Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI



Analysers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

#### Unit 4

10 Hrs

**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

- a) Thin Layer chromatography
- b) High Performance Thin Layer Chromatography
- c) Ion exchange chromatography
- d) Column chromatography
- e) Gas chromatography
- f) High Performance Liquid chromatography
- g) Ultra High Performance Liquid chromatography
- h) Affinity chromatography
- i) Gel Chromatography

#### Unit 5

10 Hrs

**Electrophoresis:** Principle, Instrumentation, working conditions, factors affecting separation and applications of the following:

- a) Paper electrophoresis
- b) Gel electrophoresis
- c) Capillary electrophoresis
- d) Zone electrophoresis
- e) Moving boundary electrophoresis
- f) Iso electric focusing

**X ray Crystallography:** Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

#### Unit 6

10 Hrs

**Potentiometry:** Principle, working, Ion selective Electrodes and Application of potentiometry.

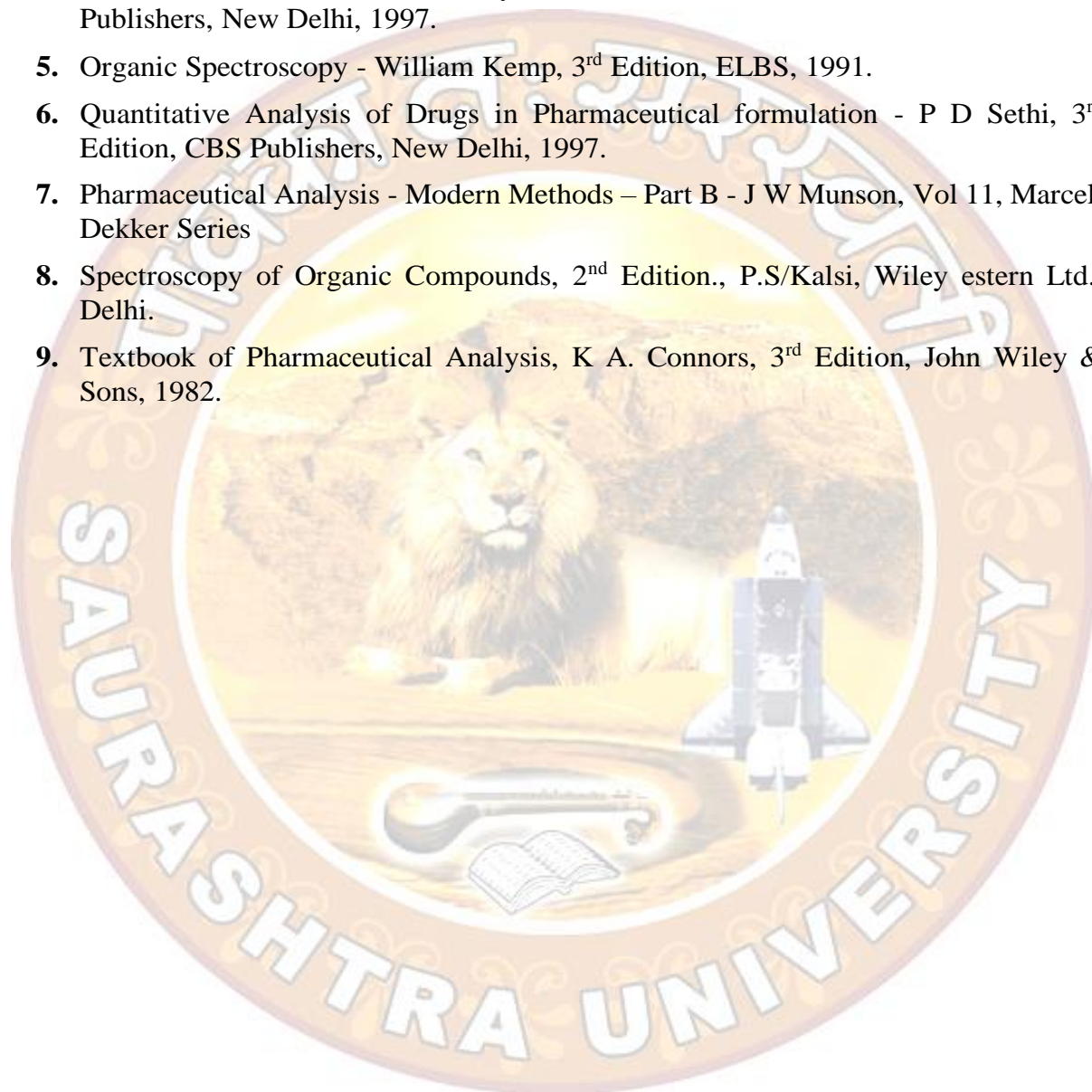
**Thermal Techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.

**Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA).

**TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

## REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, 6<sup>th</sup> Edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5<sup>th</sup> Edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7<sup>th</sup> Edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4<sup>th</sup> Edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3<sup>rd</sup> Edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3<sup>rd</sup> Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series
8. Spectroscopy of Organic Compounds, 2<sup>nd</sup> Edition., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, K A. Connors, 3<sup>rd</sup> Edition, John Wiley & Sons, 1982.



# M. PHARM (QA) SEMESTER I

## QUALITY MANAGEMENT SYSTEMS (MQA 102T)

**Theory: 4 Hrs. /Week**

### Scope

This course is designed to impart fundamental knowledge and concepts about various quality management principles and systems utilized in the manufacturing industry. It also aids in understanding the quality evaluation in the pharmaceutical industries.

### Objectives

At completion of this course it is expected that students will be able to understand-

- The importance of quality
- ISO management systems
- Tools for quality improvement
- Analysis of issues in quality
- Quality evaluation of pharmaceuticals
- Stability testing of drug and drug substances
- Statistical approaches for quality

### Course Outcome

- CO1:** Got fundamental knowledge and concepts about various quality management principles and systems utilized in the manufacturing industry.
- CO2:** Understand the importance of quality, tools for quality improvement, quality evaluation of pharmaceuticals.
- CO3:** Familiarized with statistical approaches for quality.
- CO4:** Understand the concept of stability testing of drug products and drug substances.

### Course content

#### Unit 1.

**12 Hrs**

- a) Introduction to Quality: Evolution of Quality, Definition of Quality, Dimensions of Quality
- b) Quality as a Strategic Decision: Meaning of strategy and strategic quality management, mission and vision statements, quality policy, Quality objectives, strategic planning and implementation, McKinsey 7s model, Competitive analysis, Management commitment to quality
- c) Customer Focus: Meaning of customer and customer focus, Classification of customers, Customer focus, Customer perception of quality, Factors affecting customer perception, Customer requirements, Meeting customer needs and expectations, Customer satisfaction and Customer delight, Handling customer complaints, Understanding customer behaviour, concept of internal and external customers. Case studies.
- d) Cost of Quality: Cost of quality, Categories of cost of Quality, Models of cost of quality, optimising costs, Preventing cost of quality.

**Unit 2. 12 Hrs**

**Pharmaceutical quality Management:** Basics of Quality Management, Total Quality Management (TQM), Principles of Six sigma, ISO 9001:2008, 9001:2015, ISO 14001:2004, Pharmaceutical Quality Management – ICH Q10, Knowledge management, Quality Metrics, Operational Excellence and Quality Management Review. OSHAS guidelines, NABL certification and accreditation, CFR-21 part 11, WHO-GMP requirements.

**Unit 3. 12 Hrs**

**Six System Inspection model:** Quality Management system Production system, Facility and Equipment system, Laboratory control system, Materials system, Packaging and labelling system. Concept of self-inspection.

**Quality systems:** Change Management/ Change control. Deviations, Out of Specifications (OOS), Out of Trend (OOT), Complaints - evaluation and handling, Investigation and determination of root cause, Corrective & Preventive Actions (CAPA), Returns and Recalls, Vendor Qualification, Annual Product Reviews, Batch Review and Batch Release. Concept of IPQC, area clearance/ Line clearance.

**Unit 4. 12 Hrs**

**Drug Stability:** ICH guidelines for stability testing of drug substances and drug products. Study of ICH Q8, Quality by Design and Process development report Quality risk management: Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guidelines.

**Unit 5. 8 Hrs**

**Statistical Process control (SPC):** Definition and Importance of SPC, Quality measurement in manufacturing, Statistical control charts - concepts and general aspects, Advantages of statistical control, Process capability, Estimating Inherent or potential capability from a control chart analysis, Measuring process control and quality improvement, Pursuit of decreased process variability.

**Unit 6. 4 Hrs**

**Regulatory Compliance through Quality Management and development of Quality Culture Benchmarking:** Definition of benchmarking, Reasons for benchmarking, Types of Benchmarking, Benchmarking process, Advantages of benchmarking, Limitations of benchmarking.

**REFERENCES**

10. Implementing Juran's Road Map for Quality Leadership: Benchmarks and Results, By Al Endres, Wiley, 2000
11. Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, By Jiju Antony; David Preece, Routledge, 2002
12. Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000: The CEO Report By Edward E. Lawler; Susan Albers Mohrman; George Benson, Jossey-Bass, 2001
13. Corporate Culture and the Quality Organization By James W. Fairfield-Sonn, Quorum Books, 2001

14. The Quality Management Sourcebook: An International Guide to Materials and Resources by Christine Avery; Diane Zabel, Routledge, 1997
15. The Quality Toolbox, Second Edition, Nancy R. Tague, ASQ Publications
16. Juran's Quality Handbook, Sixth Edition, Joseph M. Juran and Joseph A. De Feo, ASQ Publications
17. Root Cause Analysis, The Core of Problem Solving and Corrective Action, Duke Okes, 2009, ASQ Publications.



# M. PHARM (QA) SEMESTER I

## QUALITY CONTROL AND QUALITY ASSURANCE

### (MQA 103T)

**Theory: 4 Hrs. /Week**

#### Scope

This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It covers the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

#### Objectives

Upon completion of this course the student should be able to

- Understand the cGMP aspects in a pharmaceutical industry
- To appreciate the importance of documentation
- To understand the scope of quality certifications applicable to Pharmaceutical industries
- To understand the responsibilities of QA & QC departments.

#### Course Outcome

**CO1:** Understand Various aspects of quality control and quality assurance in pharmaceutical industries.

**CO2:** Familiarised with important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

**CO3:** Understand the importance of documentation and responsibilities of QA & QC departments.

**CO:4** Understand the scope of quality certifications applicable to pharmaceutical industries.

#### Course content

##### Unit 1.

**12 Hrs**

**Introduction:** Concept and evolution and scopes of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICH Guidelines - QSEM, with special emphasis on Qseries guidelines.

**Good Laboratory Practices:** Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non-clinical testing, control on animal house, report preparation and documentation.

**CPCSEA guidelines.**

##### Unit 2.

**12 Hrs**

cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER) Pharmaceutical Inspection Convention(PIC), WHO and EMEA covering: Organization and personnel responsibilities, training, hygiene and personal records, drug industry location, design, construction and plant lay out, maintenance, sanitation, environmental control,

utilities and maintenance of sterile areas, control of contamination and Good Warehousing Practice.

### **Unit 3.**

**12 Hrs**

Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), Developing specification (ICH Q6 and Q3), purchase specifications and maintenance of stores for raw materials.

In process quality control and finished products quality control for following dosage forms in Pharma industry according to Indian, US and British pharmacopoeias: tablets, capsules, ointments, suppositories, creams, parenterals, ophthalmic and surgical products (How to refer pharmacopoeias).

### **Unit 4.**

**12 Hrs**

**Documentation in pharmaceutical industry:** Three tier documentation, Policy, Procedures and Work instructions, and records (Formats), Basic principles- How to maintain, retention and retrieval etc. Standard operating procedures (How to write), Master Batch Record, Batch Manufacturing Record, Quality audit plan and reports. Specification and test procedures, Protocols and reports. Distribution records. Electronic data handling. Concepts of controlled and uncontrolled documents.

Submission documents for regulators DMFs, as Common Technical Document and Electronic Common Technical Documentation (CTD, eCTD). Concept of regulated and non-regulated markets.

### **Unit 5.**

**12 Hrs**

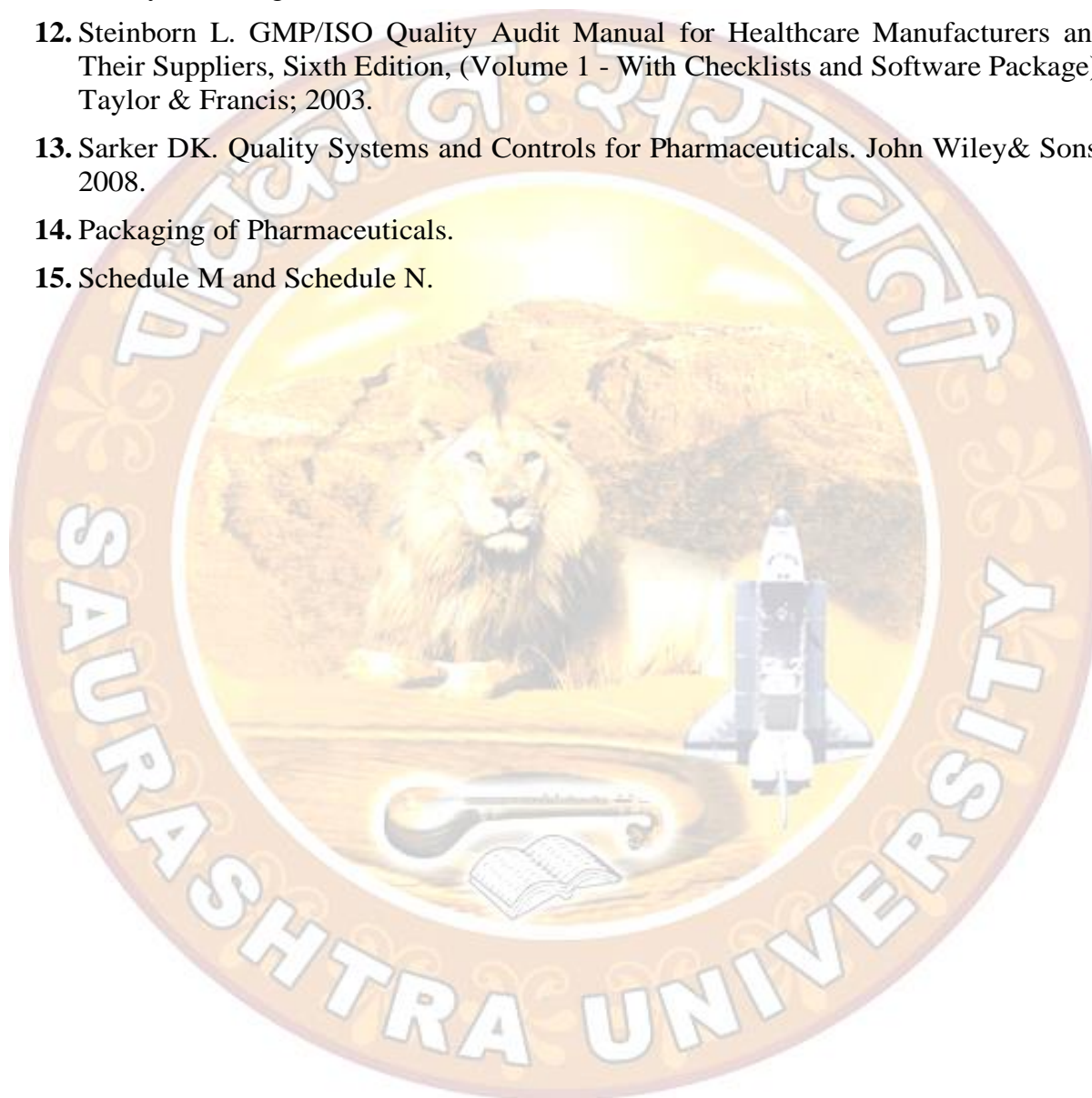
**Manufacturing operations and controls:** Sanitation of manufacturing premises, mix-ups and cross contamination, processing of intermediates and bulk products, packaging operations, IPQC, release of finished product, process deviations, charge-in of components, time limitations on production, drug product inspection, expiry date calculation, calculation of yields, production record review, change control, sterile products, aseptic process control, packaging, reprocessing, salvaging, handling of waste and scrap disposal.

Introduction, scope and importance of intellectual property rights. Concept of trade mark, copyright and patents.

## **REFERENCES**

1. Quality Assurance Guide by organization of Pharmaceutical Procedures of India, 3rd revised edition, Volume I & II, Mumbai, 1996.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69, Marcel Dekker Series, 1995.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999.
4. How to Practice GMP's – P P Sharma, Vandana Publications, Agra, 1991.
5. The International Pharmacopoeia – vol I, II, III, IV & V - General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms, 3rd edition, WHO, Geneva, 2005.
6. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series, 1989.

7. ICH guidelines
8. ISO 9000 and total quality management
9. The drugs and cosmetics act 1940 – Deshpande, Nilesh Gandhi, 4th edition, Susmit Publishers, 2006.
10. QA Manual – D.H. Shah, 1st edition, Business Horizons, 2000.
11. Good Manufacturing Practices for Pharmaceuticals a plan for total quality control – Sidney H. Willig, Vol. 52, 3rd edition, Marcel Dekker Series.
12. Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis; 2003.
13. Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley& Sons; 2008.
14. Packaging of Pharmaceuticals.
15. Schedule M and Schedule N.





**M. PHARM (QA) SEMESTER I**  
**PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER**  
**(MQA 104T)**

**Theory: 4 Hrs. /Week**

**Scope**

This deal with technology transfer covers the activities associated with Drug Substance, Drug Product and analytical tests and methods, required following candidate drug selection to completion of technology transfer from R&D to the first receiving site and technology transfer related to post-marketing changes in manufacturing places.

**Objectives**

Upon completion of this course the student should be able to

- To understand the new product development process
- To understand the necessary information to transfer technology from R&D to actual manufacturing by sorting out various information obtained during R&D
- To elucidate necessary information to transfer technology of existing products between various manufacturing places

**Course Outcome**

**CO1:** Understood the concept of technology transfer from R&D to first receiving site and technology transfer related to post-marketing changes in manufacturing places.

**CO2:** Understand the new product development process.

**CO3:** Understand the necessary information to transfer technology from R&D to actual manufacturing by sorting out various information obtained during R&D.

**CO4:** Familiarized with basic principles of drug discovery and development like IND, NDA, ANDA etc..

**Course content**

**Unit 1.**

**12 Hrs**

**Principles of Drug discovery and development:** Introduction, Clinical research process. Development and informational content for Investigational New Drugs Application (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Supplemental New Drug Application (SNDA), Scale Up Post Approval Changes (SUPAC) and Bulk active chemical Post approval changes (BACPAC), Post marketing surveillance, Product registration guidelines – CDSCO, USFDA.

**Unit 2.**

**12 Hrs**

**Pre-formulation studies:** Introduction/concept, organoleptic properties, purity, impurity profiles, particle size, shape and surface area. Solubility, Methods to improve solubility of Drugs: Surfactants & its importance, co-solvency. Techniques for the study of Crystal properties and polymorphism. Pre-formulation protocol, Stability testing during product development.

**Unit 3.****12 Hrs**

**Pilot plant scale up:** Concept, Significance, design, layout of pilot plant scale up study, operations, large scale manufacturing techniques (formula, equipment, process, stability and quality control) of solids, liquids, semisolid and parenteral dosage forms.

**New era of drug products:** opportunities and challenges.

**Unit 4.****12 Hrs**

Pharmaceutical packaging: Pharmaceutical dosage form and their packaging requirements, Pharmaceutical packaging materials, Medical device packaging, Enteral Packaging, Aseptic packaging systems, Container closure systems, Issues facing modern drug packaging, Selection and evaluation of Pharmaceutical packaging materials.

Quality control test: Containers, closures and secondary packing materials.

**Unit 5.****12 Hrs**

**Technology transfer:** Development of technology by R & D, Technology transfer from R & D to production, Optimization and Production, Qualitative and quantitative technology models.

**Documentation in technology transfer:** Development report, technology transfer plan and Exhibit.

**REFERENCES**

16. The process of new drug discovery and development. I and II Edition (2006) by Charles G. Smith, James T and O. Donnell. CRC Press, Group of Taylor and Francis.
17. Leon Lac Lachman, Herbert A. Liberman, Theory and Practice of Industrial Pharmacy. Marcel Dekker Inc. New York.
18. Sidney H Willing, Murray M, Tuckerman. Williams Hitchings IV, Good manufacturing of pharmaceuticals (A Plan for total quality control) 3rd Edition. Bhalani publishing house Mumbai.
19. Tablets Vol. I, II, III by Leon Lachman, Herbert A. Liberman, Joseph B. Schwartz, 2nd Edn. (1989) Marcel Dekker Inc. New York.
20. Text book of Bio- Pharmaceutics and clinical Pharmacokinetics by Milo Gibaldi, 3rd Edn, Lea & Febriger, Philadelphia.
21. Pharmaceutical product development. Vandana V. Patrevala. John I. Disouza. Maharukh T. Rustomji. CRC Press, Group of Taylor and Francis.
22. Dissolution, Bioavailability and Bio-Equivalence by Abdou H.M, Mack Publishing company, Eastern Pennsylvania.
23. Remingtons Pharmaceutical Sciences, by Alfonso & Gennaro, 19th Edn.(1995)OO2C Lippincott; Williams and Wilkins A Wolters Kluwer Company, Philadelphia.
24. The Pharmaceutical Sciences; the Pharma Path way 'Pure and applied Pharmacy' by D. A Sawant, Pragathi Books Pvt. Ltd.
25. Pharmaceutical Packaging technology by D.A. Dean. E.R. Evans, I.H. Hall. 1st Edition(Reprint 2006). Taylor and Francis. London and New York.

**M. PHARM (QA) SEMESTER I**  
**QUALITY ASSURANCE PRACTICAL – I (MQA 105P)**  
**Practical: 12 Hrs. /Week**

**PRACTICALS**

26. Analysis of Pharmacopoeial compounds in bulk and in their formulations (tablet/capsules/ semisolids) by UV Vis spectrophotometer
27. Simultaneous estimation of multi-drug component containing formulations by UV spectrophotometry
28. Experiments based on HPLC
29. Experiments based on Gas Chromatography
30. Estimation of riboflavin/quinine sulphate by fluorimetry
31. Estimation of sodium/potassium by flame photometry or AAS
32. Case studies on
  - Total Quality Management
  - Six Sigma
  - Change Management/ Change control. Deviations,
  - Out of Specifications (OOS)
  - Out of Trend (OOT)
  - Corrective & Preventive Actions (CAPA)
  - Deviations
33. Development of Stability study protocol
34. Estimation of process capability
35. In process and finished product quality control tests for tablets, capsules, parenterals and semisolid dosage forms.
36. Assay of raw materials as per official monographs
37. Testing of related and foreign substances in drugs and raw materials
38. To carry out pre formulation study for tablets, parenterals (2 experiment).
39. To study the effect of pH on the solubility of drugs, (1 experiment)
40. Quality control tests for Primary and secondary packaging materials
41. Accelerated stability studies (1 experiment)
42. Improved solubility of drugs using surfactant systems (1 experiment)
43. Improved solubility of drugs using co-solvency method (1 experiment)
44. Determination of Pka and Log p of drugs.

## **M. PHARM (QA) SEMESTER II HAZARDS AND SAFETY MANAGEMENT (MQA 201T)**

**Theory: 4 Hrs. /Week**

### **Scope**

This course is designed to convey the knowledge necessary to understand issues related to different kinds of hazard and their management. Basic theoretical and practical discussions integrate the proficiency to handle the emergency situation in the pharmaceutical product development process and provides the principle-based approach to solve the complex tribulations.

### **Objectives**

At completion of this course it is expected that students will be able to

- Understand about environmental problems among learners.
- Impart basic knowledge about the environment and its allied problems.
- Develop an attitude of concern for the industry environment.
- Ensure safety standards in pharmaceutical industry
- Provide comprehensive knowledge on the safety management
- Empower an ideas to clear mechanism and management in different
- kinds of hazard management system
- Teach the method of Hazard assessment, procedure, methodology for
- provide safe industrial atmosphere.

### **Course outcome**

- CO1:** Realization of environmental problems and gain the knowledge of environment and its allied problems.
- CO2:** They are aware about actual industry environment and know the safety standards in pharmaceutical industry.
- CO3:** They gain comprehensive knowledge on the safety management
- CO4:** Develop thoughts of management mechanism in various types of hazard management system.
- CO5:** Know about hazards assessment methodology and its application at industry for safety.

### **Course content**

#### **Unit 1.**

**12 Hrs**

**Multidisciplinary nature of environmental studies:** Natural Resources, Renewable and non-renewable resources, Natural resources and associated problems:

- a) Forest resources;
- b) Water resources;
- c) Mineral resources;
- d) Energy resources;

e) Land resources Ecosystems

Concept of an ecosystem and Structure and function of an ecosystem. Environmental hazards: Hazards based on Air, Water, Soil and Radioisotopes.

**Unit 2. 12 Hrs**

**Air based hazards:** Sources, Types of Hazards, Air circulation maintenance industry for sterile area and non-sterile area, Preliminary Hazard Analysis (PHA) Fire protection system: Fire prevention, types of fire extinguishers and critical Hazard management system.

**Unit 3. 12 Hrs**

**Chemical based hazards:** Sources of chemical hazards, Hazards of Organic synthesis, sulphonating hazard, Organic solvent hazard, Control measures for chemical hazards, Management of combustible gases, Toxic gases and Oxygen displacing gases management, Regulations for chemical hazard, Management of over-Exposure to chemicals and TLV concept.

**Unit 4. 12 Hrs**

**Fire and Explosion:** Introduction, Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Fire protection system: Fire prevention, types of fire extinguishers and critical Hazard management system mechanical and chemical explosion, multiphase reactions, transport effects and global rates. Preventive and protective management from fires and explosion electricity passivation, ventilation, and sprinkling, proofing, relief systems -relief valves, flares, scrubbers.

**Unit 5. 12 Hrs**

**Hazard and risk management:** Self-protective measures against workplace hazards. Critical training for risk management, Process of hazard management, ICH guidelines on risk assessment and Risk management methods and Tools Factory act and rules, fundamentals of accident prevention, elements of safety programme and safety management, Physicochemical measurements of effluents, BOD, COD, Determination of some contaminants, Effluent treatment procedure, Role of emergency services.

**REFERENCES**

45. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
46. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
47. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India,
48. Hazardous Chemicals: Safety Management and Global Regulations, T.S.S. Dikshith, CRC press

## **M. PHARM (QA) SEMESTER II PHARMACEUTICAL VALIDATION (MQA 202T)**

**Theory: 4 Hrs. /Week**

### **Scope**

The main purpose of the subject is to understand about validation and how it can be applied to industry and thus improve the quality of the products. The subject covers the complete information about validation, types, methodology and application.

### **Objectives**

At completion of this course, it is expected that students will be able to understand

- The concepts of calibration, qualification and validation
- The qualification of various equipments and instruments
- Process validation of different dosage forms
- Validation of analytical method for estimation of drugs
- Cleaning validation of equipment employed in the manufacture of pharmaceuticals

### **Course outcome**

**CO1:** Demonstrate the knowledge of calibration, qualification and validation for various aspects of pharmaceutical analytical, bio-analytical and quality assurance.

**CO2:** Knowledge about the qualification of various manufacturing, analytical and laboratory equipment.

**CO3:** Knowledge about types, application and guidelines of process validation.

**CO4:** State the concept of analytical method development and validation parameters for estimation of analytes.

**CO5:** Cleaning validation of equipment employed in the manufacture of pharmaceuticals

**CO6:** Information about intellectual property rights

### **Course content**

#### **Unit 1.**

**10 Hrs**

**Introduction to validation:** Definition of Calibration, Qualification and Validation, Scope, frequency and importance. Difference between calibration and validation. Calibration of weights and measures. Advantages of Validation, scope of Validation, Organization for Validation, Validation Master plan, Types of Validation, Streamlining of qualification & Validation process and Validation Master Plan.

**Qualification:** User requirement specification, Design qualification, Factory Acceptance Test (FAT)/Site Acceptance Test (SAT), Installation qualification, Operational qualification, Performance qualification, Re-Qualification (Maintaining status- Calibration Preventive Maintenance, Change management).

**Unit 2. 10 Hrs**

**Qualification of manufacturing equipment:** Dry Powder Mixers, Fluid Bed and Tray dryers, Tablet Compression (Machine), Dry heat sterilization/Tunnels, Autoclaves, Membrane filtration, Capsule filling machine.

**Qualification of analytical instruments:** UV-Visible spectrophotometer, FTIR, DSC, GC, HPLC, HPTLC, LC-MS.

**Unit 3. 10 Hrs**

**Qualification of laboratory equipments:** Hardness tester, Friability test apparatus, tap density tester, Disintegration tester, Dissolution test apparatus

**Validation of Utility systems:** Pharmaceutical water system & pure steam, HVAC system, Compressed air and nitrogen.

**Unit 4. 10 Hrs**

**Process Validation:** Concept, Process and documentation of Process Validation. Prospective, Concurrent & Retrospective Validation, Re validation criteria, Process Validation of various formulations (Coated tablets, Capsules, Ointment/Creams, Liquid Orals and aerosols.), Aseptic filling: Media fill validation, USFDA guidelines on Process Validation- A life cycle approach.

**Analytical method validation:** General principles, Validation of analytical method as per ICH guidelines and USP.

**Unit 5. 10 Hrs**

**Cleaning Validation:** Cleaning Method development, Validation of analytical method used in cleaning, Cleaning of Equipment, Cleaning of Facilities. Cleaning in place (CIP). Validation of facilities in sterile and non-sterile plant.

**Computerized system validation:** Electronic records and digital signature - 21 CFR Part 11 and GAMP

**Unit 6. 10 Hrs**

**General Principles of Intellectual Property:** Concepts of Intellectual Property (IP), Intellectual Property Protection (IPP), Intellectual Property Rights (IPR); Economic importance, mechanism for protection of Intellectual Property –patents, Copyright, Trademark; Factors affecting choice of IP protection; Penalties for violation; Role of IP in pharmaceutical industry; Global ramification and financial implications.

**Filing a patent application:** patent application forms and guidelines. Types patent applications-provisional and non-provisional, PCT and convention patent applications; International patenting requirement procedures and costs; Rights and responsibilities of a patentee; Practical aspects regarding maintaining of a Patent file; Patent infringement meaning and scope. Significance of transfer technology (TOT), IP and ethics-positive and negative aspects of IPP; Societal responsibility, avoiding unethical practices.

**REFERENCES**

1. B. T. Loftus & R. A. Nash, "Pharmaceutical Process Validation", Drugs and Pharm Sci. Series, Vol. 129, 3rd Ed., Marcel Dekker Inc., N.Y.

2. The Theory & Practice of Industrial Pharmacy, 3rd edition, Leon Lachman, Herbert A. Lieberman, Joseph. L. Karig, Varghese Publishing House, Bombay.
3. Validation Master plan by Terveeks or Deeks, Davis Harwood International publishing.
4. Validation of Aseptic Pharmaceutical Processes, 2nd Edition, by Carleton & Agalloco, (Marcel Dekker).
5. Michael Levin, Pharmaceutical Process Scale-Up”, Drugs and Pharm. Sci. Series, Vol. 157,2nd Ed., Marcel Dekker Inc., N.Y.
6. Validation Standard Operating Procedures: A Step by Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotech Industries, Syed Imtiaz Haider
7. Pharmaceutical Equipment Validation: The Ultimate Qualification Handbook, Phillip A. Cloud, Interpharm Press
8. Validation of Pharmaceutical Processes: Sterile Products, Frederick J. Carlton (Ed.) and James Agalloco (Ed.), Marcel Dekker
9. Analytical Method validation and Instrument Performance Verification by Churg Chan, Heiman Lam, Y.C. Lee, Yue. Zhang, Wiley Interscience.
10. Huber L. Validation and Qualification in Analytical Laboratories. Informa Healthcare
11. Wingate G. Validating Corporate Computer Systems: Good IT Practice for Pharmaceutical Manufacturers. Interpharm Press
12. LeBlanc DA. Validated Cleaning Technologies for Pharmaceutical Manufacturing. Interpharm Press



**M. PHARM (QA) SEMESTER II**  
**AUDITS AND REGULATORY COMPLIANCE (MQA 203T)**  
**Theory: 4 Hrs. /Week**

**Scope**

This course deals with the understanding and process for auditing in pharmaceutical industries. This subject covers the methodology involved in the auditing process of different in pharmaceutical industries.

**Objectives**

Upon completion of this course the student should be able to

- To understand the importance of auditing
- To understand the methodology of auditing
- To carry out the audit process
- To prepare the auditing report
- To prepare the check list for auditing

**Course outcome**

**CO1:** Importance of audit in pharma industry and also help to develop the professional skills required for a dynamic professional.

**CO2:** Know about the methodology of audit in various departments of Pharmaceuticals.

**CO3:** Develop the leadership qualities and interpersonal skills for carry out the audit process

**CO4:** Prepare the check list for auditing of various pharmaceutical department and audit report

**Course content**

**Unit 1. 12 Hrs**

**Introduction:** Objectives, Management of audit, Responsibilities, Planning process, information gathering, administration, Classifications of deficiencies

**Unit 2. 12 Hrs**

**Role of quality systems and audits in pharmaceutical manufacturing environment:** cGMP Regulations, Quality assurance functions, Quality systems approach, Management responsibilities, Resource, Manufacturing operations, Evaluation activities, Transitioning to quality system approach, Audit checklist for drug industries.

**Unit 3. 12 Hrs**

**Auditing of vendors and production department:** Bulk Pharmaceutical Chemicals and packaging material Vendor audit, Warehouse and weighing, Dry Production: Granulation, tableting, coating, capsules, sterile production and packaging.

**Unit 4.****12 Hrs**

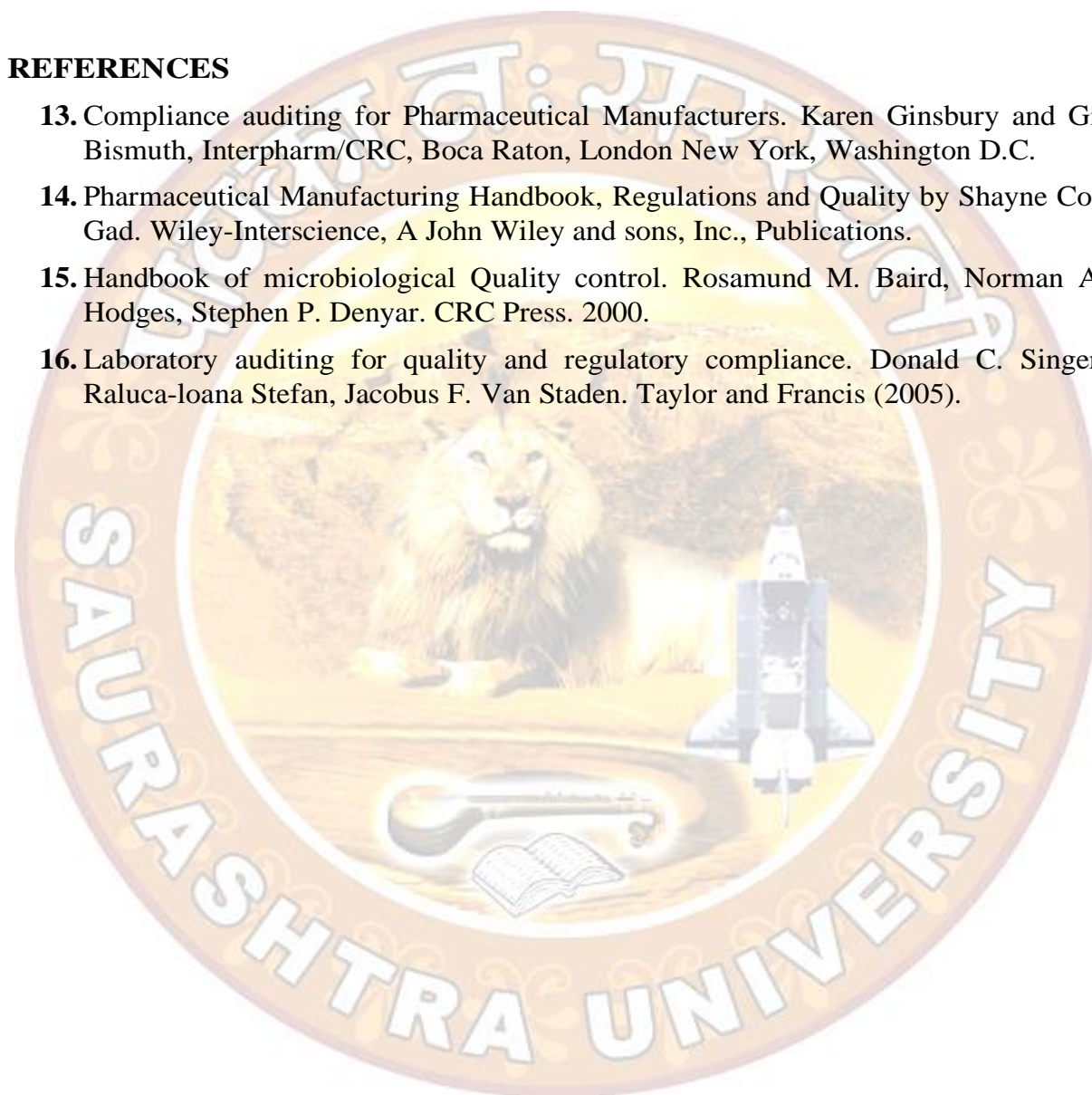
**Auditing of Microbiological laboratory:** Auditing the manufacturing process, Product and process information, General areas of interest in the building raw materials, Water, Packaging materials.

**Unit 5.****12 Hrs**

**Auditing of Quality Assurance and engineering department:** Quality Assurance Maintenance, Critical systems: HVAC, Water, Water for Injection systems, ETP.

**REFERENCES**

13. Compliance auditing for Pharmaceutical Manufacturers. Karen Ginsbury and Gil Bismuth, Interpharm/CRC, Boca Raton, London New York, Washington D.C.
14. Pharmaceutical Manufacturing Handbook, Regulations and Quality by Shayne Cox Gad. Wiley-Interscience, A John Wiley and sons, Inc., Publications.
15. Handbook of microbiological Quality control. Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyar. CRC Press. 2000.
16. Laboratory auditing for quality and regulatory compliance. Donald C. Singer, Raluca-loana Stefan, Jacobus F. Van Staden. Taylor and Francis (2005).



# M. PHARM (QA) SEMESTER II

## PHARMACEUTICAL MANUFACTURING TECHNOLOGY

### (MQA 204T)

**Theory: 4 Hrs. /Week**

#### Scope

This course is designed to impart knowledge and skills necessary to train the students with the industrial activities during Pharmaceutical Manufacturing.

#### Objectives

At completion of this course it is expected that students will be able to understand,

- The common practice in the pharmaceutical industry developments, plant layout and production planning
- Will be familiar with the principles and practices of aseptic process technology, non sterile manufacturing technology and packaging technology.
- Have a better understanding of principles and implementation of Quality by design (QbD) and process analytical technology (PAT) in pharmaceutical manufacturing

#### Course outcome

**CO1:** Practices and legal requirements for pharmaceutical industry developments, plant layout and production planning.

**CO2:** Information about the general principles and practices for aseptic process technology, non-sterile manufacturing technology and packaging technology.

**CO3:** Understanding the concept regarding the implementation of Quality by design (QbD) and its elements and process analytical technology (PAT) in pharmaceutical manufacturing

#### Course content

##### Unit 1.

**12 Hrs**

**Pharmaceutical industry developments:** Legal requirements and Licenses for API and formulation industry, Plant location-Factors influencing.

**Plant layout:** Factors influencing, Special provisions, Storage space requirements, sterile and aseptic area layout.

**Production planning:** General principles, production systems, calculation of standard cost, process planning, routing, loading, scheduling, dispatching of records, production control.

##### Unit 2.

**12 Hrs**

**Aseptic process technology:** Manufacturing, manufacturing flowcharts, in process-quality control tests for following sterile dosage forms: Ointment, Suspension and Emulsion, Dry powder, Solution (Small Volume & large Volume).

**Advanced sterile product manufacturing technology:** Area planning & environmental control, wall and floor treatment, fixtures and machineries, change rooms, personnel flow, utilities & utilities equipment location, engineering and maintenance. Process Automation in Pharmaceutical Industry: With specific reference to manufacturing of sterile semisolids,

Small Volume Parenterals & Large Volume Parenterals (SVP & LVP), Monitoring of Parenteral manufacturing facility, Cleaning in Place (CIP), Sterilization in Place (SIP), Prefilled Syringe, Powdered Jet, Needle Free Injections, and Form Fill Seal Technology (FFS).

**Lyophilization technology:** Principles, process, equipment.

### Unit 3.

12 Hrs

**Non sterile manufacturing process technology:** Manufacturing, manufacturing flowcharts, in process-quality control tests for following Non-Sterile solid dosage forms: Tablets (compressed & coated), Capsules (Hard & Soft).

**Advance non-sterile solid product manufacturing technology:** Process Automation in Pharmaceutical Industry with specific reference to manufacturing of tablets and coated

**products, Improved Tablet Production:** Tablet production process, granulation and pelletization equipments, continuous and batch mixing, rapid mixing granulators, rota granulators, spheronizers and marumerisers, and another specialized granulation and drying equipments. Problems encountered.

**Coating technology:** Process, equipments, particle coating, fluidized bed coating, application techniques. Problems encountered.

### Unit 4.

12 Hrs

**Containers and closures for pharmaceuticals:** Types, performance, assuring quality of glass; types of plastics used, Drug plastic interactions, biological tests, modification of plastics by drugs; different types of closures and closure liners; film wrapper; blister packs; bubble packs; shrink packaging; foil / plastic pouches, bottle seals, tape seals, breakable seals and sealed tubes; quality control of packaging material and filling equipment, flexible packaging, product package compatibility, transit worthiness of package, Stability aspects of packaging. Evaluation of stability of packaging material.

### Unit 5.

12 Hrs

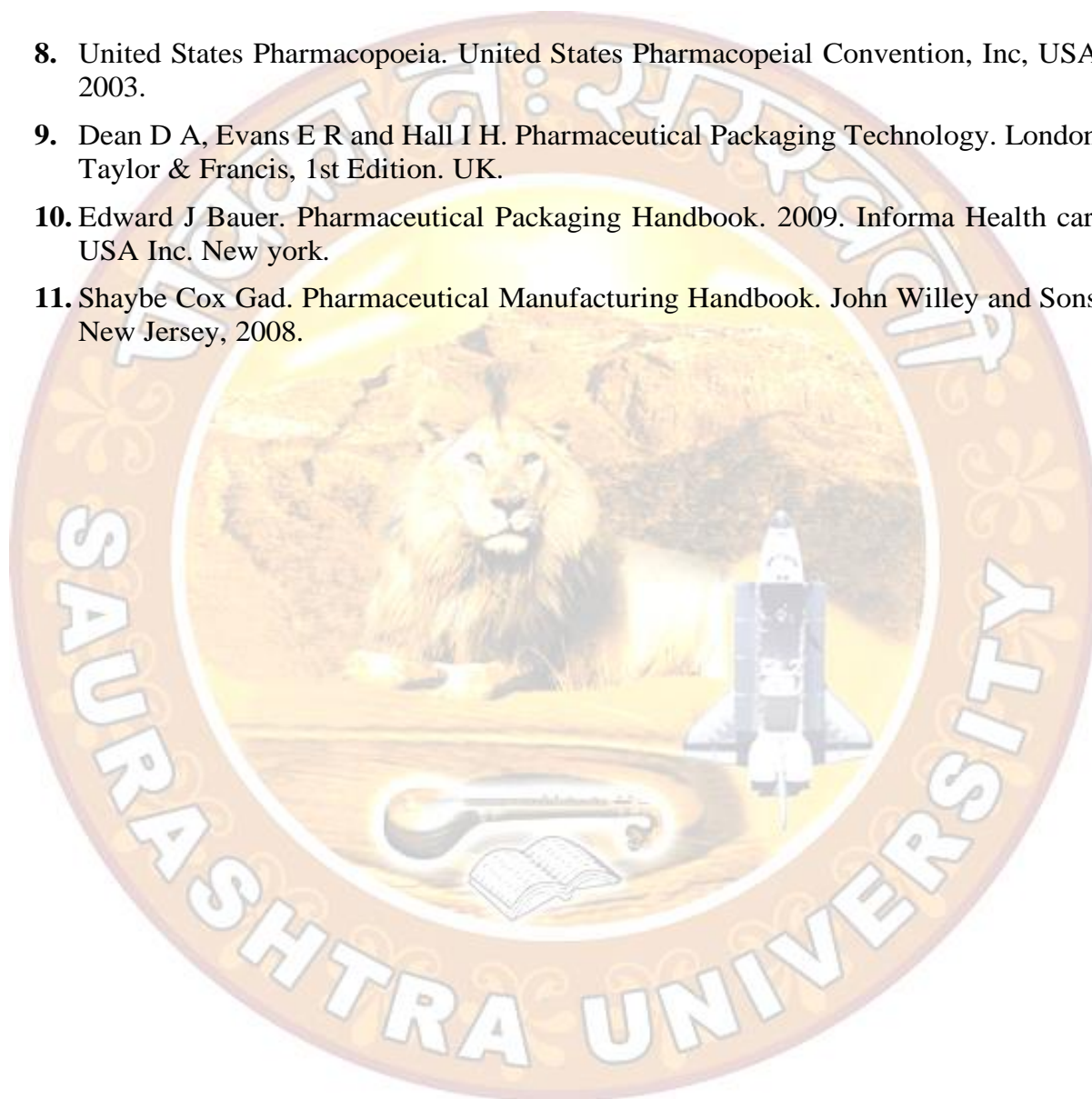
**Quality by design (QbD) and process analytical technology (PAT):** Current approach and its limitations. Why QbD is required, Advantages, Elements of QbD, Terminology: QTPP, CMA, CQA, CPP, RLD, Design space, Design of Experiments, Risk Assessment and mitigation/minimization. Quality by Design, Formulations by Design, QbD for drug products, QbD for Drug Substances, QbD for Excipients, Analytical QbD. FDA initiative on process analytical technology.

**PAT as a driver for improving quality and reducing costs:** quality by design (QbD), QA, QC and GAMP. PAT guidance, standards and regulatory requirements.

## REFERENCES

1. Lachman L, Lieberman HA, Kanig JL. The theory and practice of industrial pharmacy, 3rd ed., Varghese Publishers, Mumbai 1991.
2. Sinko PJ. Martin's physical pharmacy and pharmaceutical sciences, 5<sup>th</sup> ed., B.I. Publications Pvt. Ltd, Noida, 2006.
3. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms: tablets Vol. I-III, 2<sup>nd</sup> ed., CBS Publishers & distributors, New Delhi, 2005.

4. Banker GS, Rhodes CT. Modern Pharmaceutics, 4th ed., Marcel Dekker, Inc, New York, 2005.
5. Sidney H Willing, Murray M, Tuckerman. Williams Hitchings IV, Good manufacturing of pharmaceuticals (A Plan for total quality control) 3rd Edition. Bhalani publishing house Mumbai.
6. Indian Pharmacopoeia. Controller of Publication. Delhi, 1996.
7. British Pharmacopoeia. British Pharmacopoeia Commission Office, London, 2008.
8. United States Pharmacopoeia. United States Pharmacopoeial Convention, Inc, USA, 2003.
9. Dean D A, Evans E R and Hall I H. Pharmaceutical Packaging Technology. London, Taylor & Francis, 1st Edition. UK.
10. Edward J Bauer. Pharmaceutical Packaging Handbook. 2009. Informa Health care USA Inc. New york.
11. Shaybe Cox Gad. Pharmaceutical Manufacturing Handbook. John Willey and Sons, New Jersey, 2008.



**M. PHARM (QA) SEMESTER II**  
**QUALITY ASSURANCE PRACTICAL – II PRACTICALS**  
**(MQA 205P)**

**Practical: 12 Hrs. /Week**

1. Organic contaminants residue analysis by HPLC
2. Estimation of Metallic contaminants by Flame photometer
3. Identification of antibiotic residue by TLC
4. Estimation of Hydrogen Sulphide in Air.
5. Estimation of Chlorine in Work Environment.
6. Sampling and analysis of SO<sub>2</sub> using Colorimetric method
7. Qualification of following Pharma equipment
  - a) Autoclave
  - b) Hot air oven
  - c) Powder Mixer (Dry)
  - d) Tablet Compression Machine
8. Validation of an analytical method for a drug
9. Validation of a processing area
10. Qualification of at least two analytical instruments
11. Cleaning validation of one equipment
12. Qualification of Pharmaceutical Testing Equipment (Dissolution testing apparatus, Friability Apparatus, Disintegration Tester)
13. Check list for Bulk Pharmaceutical Chemicals vendors
14. Check list for tableting production.
15. Check list for sterile production area
16. Check list for Water for injection.
17. Design of plant layout: Sterile and non-sterile
18. Case study on application of QbD
19. Case study on application of PAT

**M. PHARM QA SEM III**  
**Research Methodology & Biostatistics (MRM 301T)**  
**Theory: 4 Hrs. /Week**

**Scope**

This subject deals with various established methods used in pharmaceutical research.

**Objectives**

Upon completion of the course student shall be able to understand

- Learn general research methodology and the basic concepts of biostatistics.
- Understand the functions of ethics committees in medical research.

**Course Outcomes**

**CO1:** Able to carry out different parametric and non-parametric tests.

**CO2:** Learn about the ethics committee and its function in medical research.

**CO3:** Learn the guidelines for the experimentation on animals

**CO4:** Prepare protocol for Animal study.

**Course content**

**Unit 1.**

**12 Hrs**

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.

**Unit 2.**

**12 Hrs**

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxon rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

**Unit 3.**

**12 Hrs**

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

**Unit 4.**

**12 Hrs**

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, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

**Unit 5.**

**12 Hrs**

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.