

MODEL CURRICULUM

FOR

POSTGRADUATE PROGRAMME

IN

MASTERS OF PHARMACY

(PHARMACEUTICAL CHEMISTRY) - 2011



ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

7TH FLOOR, CHANDRALOK BUILDING, JANPATH

NEW DELHI – 110 001

FOREWORD

It is with great pleasure and honour that I write a forward for the Model scheme of instruction and syllabi for the Undergraduate Pharmaceutical Education Programme prepared by the All India Board of Pharmaceutical Education with Dr. S.Y. Ghabre as its Chairman and other members. All India Council for Technical Education has the onerous responsibility for uniform development and qualitative growth of the Technical Education system and preparation of syllabi to maintain uniform standards throughout the country. In pursuance to clause 10 (2) of the AICTE Act 1987 AICTE has the objective of bringing about uniformity in the curriculum of Pharmaceutical Education. In that direction, the efforts of the All India Board of Pharmaceutical Education has been quite commendable and praiseworthy. A painstaking effort was made by the Chairman, members of the Board and various working groups composed of experts from leading institutions in framing of the Instruction and Syllabi. The Board was ably assisted by the official of the Academics Bureau in successfully organizing the meetings making available necessary documents and follow up action on the minutes of the meetings.

Chairman

**All India Council for
Technical Education**

SCHEME: PHARMACEUTICAL CHEMISTRY

TERMINOLOGY: S MEANS SEMESTER, MPC MEANS MASTER OF PHARMACEUTICAL CHEMISTRY, T & TH MEANS THEORY, P & PR MEANS PRACTICAL.

CREDIT SYSTEM: 1CREDIT = 25 MARKS

Sem	Subject Code	Subject	Hours/week		CREDITS		MARKS	
			TH	PR	TH	PR	TH	PR
First	S1-MPC-1	Research Methodology	4	00	4	00	100	00
	S1-MPC-2	Modern Analytical Techniques	4	8	4	4	100	100
	S1-MPC-3	Computers & Statistics	4	4	4	2	100	50
	S1-MPC-4	Nanotechnology & Biotechnology	4	8	4	4	100	100
		Total:	16	20	16	10	400	250
Second	S2-MPC-1	Research Project	00	8	00	2	00	50
	S2-MPC-2	Advanced Pharmaceutical Chemistry - 1	4	8	4	4	100	100
	S2-MPC-3	Advanced Organic Chemistry	4	8	4	4	100	100
	S2-MPC-4	Elective – 1	4	00	4	00	100	00
		Total:	12	24	12	10	300	250
Third	S3-MPC-1	Drug Regulatory aspects & IPR	4	00	4	00	100	00
	S3-MPC-2	Research work Seminar	00	8	00	4	00	100
	S3-MPC-3	Research Project	00	16	00	6	00	150
	S3-MPC-4	Advanced Pharmaceutical Chemistry – 2	4	00	4	00	100	00
	S3-MPC-5	Elective – 2	4	00	4	00	100	00
		Total:	12	24	12	10	300	250
Fourth	S4-MPC-1	Research Project & Colloquium	00	36	00	16	00	400
		Total:	00	36	00	16	00	400
		GRAND TOTAL:	40	104	40	46	1000	1150

Name of the Course : Research and Teaching Methodology		
Course code: S1-MPC-1[T]		Semester : I
Duration : 60 Hrs		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04Hrs/week		Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : Hrs/week [N A]		End Semester Exam: 70 Marks
Credits : 04		
Aim :-		
Objective :-		
S. No		
1	To familiarize students regarding teaching methodology & research projects.	
2	To teach students preparation of a research projects & different aspects associated with it.	
3	To acquaint students with experimental data analysis.	
4	To impress upon students the importance of ethical issues in the profession & plagiarism.	
Pre-Requisite:-		
S. No		
1	A B. Pharm. degree from any AICTE approved institution or its equivalent.	
Contents		Hrs
Unit -1	Learning and instruction Principles of Instructional design and learning theory, Merrill's five principles and Gagne's condition of learning. Active learning, group learning, collaborative learning, problem-based learning, team-based learning, Experiential learning model of Kolb.	08
Unit -2	Curriculum development A six step approach- Problem identification and general needs assessment, targeted needs assessment, goals and objectives, educational strategies, implementation, evaluation and feedback. Bloom's Taxonomy, three domains of educational objectives.	06
Unit -3	Funding & Scholarship Agencies funding research in pharmaceutical sciences, Scholarship, types of scholarships in education.	03
Unit -4	Assessment Definition and methods, Georges Millers pyramid, assessment, measurement and tests, types of numbers, formative and summative assessment.	03
Unit -5	Basics of Research Definition, objectives, motivation, types of research and approaches: descriptive research, conceptual, theoretical, applied and experimental.	03
Unit -6	Formation of Research Problem A. Research Process: To determine what type of research to be done, plan of research work. B. Selection of research area, prioritization of research. C. Literature review: importance and methods, sources, D. Objectives and scope of work, developing research plan and schedule:	04

	Scheduling constraints, steps, problems in scheduling, limitations.	
Unit -7	Mathematical Modeling and Simulation Concept of modeling, classification of mathematical models, modeling with ordinary differential equations, difference equations, partial differential equations, graphs, simulation: concept, types (quantitative , experimental, computer, fuzzy theory, statistical) processes of formulation of model based on simulation. Variables and measurement.	05
Unit -8	Experimental Modeling a) Definition of experimental design, examples, single factor experiments blocking and Nuisance factors, guidelines for designing experiments. b) General model of process: Input factors/ variables, Output parameters / variables controllable / uncontrollable variables, dependent / independent variables, experimental validity. c) Introduction to Risk assessment, reliability, sustainability, and uncertainty.	04
Unit -9	Analysis of data a) Types of data: parametric and nonparametric, descriptive and inferential data, b) Collection of data: normal distribution, calculation of co-relation coefficient c) Data processing: analysis, error analysis, meaning, and different methods: analysis of variance, significance of variance, analysis of covariance, multiple regressions, testing linearity/nonlinearity of model, testing adequacy of model. d) Test to be used in data exploration and their choice e) Introduction of software used in data analysis.	08
Unit-10	Research Deliverables a) Various Forms of Publication: Thesis, paper, research proposal. b) Thesis Writing: Introduction, literature review or state-of-the-art, research approach (methodology), results or findings, discussions, conclusions, scope for future work, references, appendices. c) Presentation: Poster, thesis, proposal, and paper.	04
Uni-11	Ethical issues in research Historical perspectives, General principles on ethical consideration involving human participation, General ethical evaluation of drugs/ device/ diagnostics/ vaccines/ herbal remedies. Statement of specific principles for human genetics and genomic research. International Conference on Harmonization. Good clinical practices norms, Ethical principles related to animal experiments.	10
Unit-12	Plagiarism Issues related to plagiarism, copyright laws, acknowledging the sources, format for manuscript writing, documentation, organization of reference material, bibliography, end note.	02
	Total	60

Text Books:

Reference books :

- B.D. John, A.L. Brown and R.R. Cocking, 1999. "How People Learn: brain, mind, experience and school". Washington, DC: National Academy Press.
- J.R. Fraenkel, N.E. Wallen, 2008. "How to Design and Evaluate Research in Education", 7th Ed. Boston: McGraw-Hill.
- K.E. David, 2009. Curriculum Development for Medical Education: *A Six-Step Approach*, 2nd Ed. The John Hopkins University Press. ISBN 0-8018-9367-4.
- N. Peter, 2009. "Leadership: Theory and Practice." 3rd Ed. Thousand Oaks: Sage Publications.
- G. Bordage, B. Dawson, 2003. Experimental study design and grant writing in eight steps and 28

questions. *Medical Education*, 37(4): 376-385.

- B.J. Avolio, F.O. Walumbwa, T.J. Weber, 2009. Leadership: Current theories, research, and future directions. *Annual Review of Psychology*, 60: 421-449.
- C.R. Kothari, 2004. "Research Methodology". 2nd Ed. New Age International (p) Limited, Publishers.
- D. Montgomery, 2000. "Design of Experiments". 5th Ed. Wiley Interscience.
- K.P. Willkinson, L. Bhandarkar, "Formulation of Hypothesis". 3rd ed. Himalaya publishing, Mumbai.
- Schank Fr, 2008. "Theories of Engineering Experiments". 2nd Ed. Tata McGraw Hill.
- D.C. Montgomery, 2009. "Introduction to SQC" 6th Ed. John Willy & sons.
- Cochran & Cocks, 1957. 2nd Ed. "Experimental Design" New York, John Willy & sons.
- J.W. Best and J.V. Kahn, 2006. "Research in Education". 10th Ed. PHI publication.
- S.S. Rao, 1983. "Optimization Theory & Applications". 2nd Ed. Wiley Eastern Ltd. ND.
- P.D. Kulkarni, 1986. "Independent Study Techniques", TTTI Chandigarh.

Suggested List of Laboratory Experiments : N A

Suggested List of Assignments/Tutorial : N A

Name of the Course : Modern Analytical Techniques		
Course code: S1-MPC-2 [T & P]		Semester : I
Duration : 60 Hrs [T], 120 Hrs [P]		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : 08 Hrs/week		End Semester Exam: 70 Marks
Credits : 04 Each [T & P]		
Aim :-		
Objective:-		
S. No		
1	To familiarize students in use of modern techniques of analysis used in different areas / fields of pharmacy.	
2	To give training in use of the technique & its applications in day to day practice.	
3	To build on the basics learned at UG level & give latest advances in the area.	
4	To give more stress on application based knowledge than instrumentation based one.	
5	To give hands on training on use of as many different sophisticated instruments as possible.	
Pre-Requisite:-		
S. No		
1	Minimum two UG level courses in Pharmaceutical analysis.	
2	A B. Pharm. Degree from any AICTE approved institution or its equivalent.	
Contents		Hrs
Unit -1	Ultraviolet – Visible spectrometry: Woodward – Fisher rules for calculation of λ_{max} . Derivative spectroscopy. Introduction to Optical rotatory Dispersion and Circular Dichroism.	05
Unit -2	Fourier Transformed Infrared Spectrometry. Interpretation of Infrared spectrum.	03
Unit -3	High Resolution 1H & ^{13}C NMR Spectrometry. Theoretical calculation of chemical shifts of various carbon atoms. Techniques used for finding types of carbon like attached proton test (APT), distortion less energy polarization transfer (DEPT). Homonuclear & heteronuclear correlation spectrometry. Different 1D & 2D NMR correlation spectrometric techniques such as COSY, NOESY, HETCOR, INADEQUATE, HSBC, HMQC etc. Use of this technique in determination of absolute configuration.	15
Unit -4	Mass spectrometry: use of isotopic abundance in molecular formula calculation. Different ionization techniques like EI, CI, FD, FI, MALDI, API, ESI. Fragmentation of molecule using these techniques. Tandem mass spectrometry and its applications in pharmacy.	08
Unit -5	HPTLC: Basic instrumentation and its calibration. Analytical method development and its validation as per ICH guidelines. Quantification using HPTLC.	05
Unit -6	HPLC: Instrumentation covering detailed discussion about pumps, injector system, columns and detectors. Calibration of instrument. Analytical method	08

	development, validation as per ICH guidelines and troubleshooting. Quantification methods used in HPLC. Ultra pressure liquid chromatography.	
Unit -7	Thermoanalytical techniques: Differential Scanning Calorimetry (DSC), Thermogravimetry (TG), Thermo mechanical analysis (TMA): Principles instrumentation and applications (including interpretation of data) in pharmacy.	05
Unit -8	Radio analytical techniques used in pharmaceuticals: Isotopic dilution methods, Radioimmunoassay, ELISA etc.	06
Unit -9	Microscopy: SEM, TEM, cryomicroscopy, AFM, confocal microscopy.	05
	Total	60

Text Books:

Reference books :

- Robert M. Silverstein, Francis X. Webster, David J. Kiemle, 2009. "Spectrometric identification of organic compounds". 7th Ed. John Wiley & Sons
- Pavia D. L., 2009. "Introduction to spectroscopy". 4th, Belmont CA
- Munson & Munson, "Pharmaceutical analysis: modern methods". edited by James W. Munson, New York : M. Dekker
- Kenneth A. Connors, 2007. "A Textbook Of Pharmaceutical Analysis" 3rd Ed. Wiley India-wise
- Jens Thuro Carstensen, 2001. "Advanced pharmaceutical solids" Marcel Dekker, New York
- Joseph B. Lambert, Scott Gronert, Herbert F. Shurvell, David Lightner, Robert Graham Cooks, 2010. "Organic structural spectroscopy", 2nd Ed. Pearson Education, Limited.
- **It is strongly recommended that some standard book/s be used for practicals. The choice of book/s is left to the concerned teachers.**

Suggested List of Laboratory Experiments :

S.No	
1	Estimation of two drugs by simultaneous equation method and absorbance ratio method.
2	Calibration of UV spectrometer for wavelength and stray light.
3	Analysis of drugs by second derivative UV spectrometry.
4	Determination of pK value by UV visible spectrometry.
5	Calculation of λ_{max} values using Woodward Fisher rules.
6	Study of hydrogen bonding using IR spectrometer.
7	Interpretation of IR spectra.
8	Calibration of IR spectrometer using standard polystyrene film.
9	Interpretation of 1D proton NMR spectrum of simple compounds (10-12 carbons).
10	Interpretation of 1D 13C NMR spectrum of simple compounds (10-12 carbons).
11	Calculation of carbon chemical shifts for various carbons such as sp ³ , sp ² , sp carbon etc.
12	Assignment of m/z values to various fragments in the mass spectrum.
13	Qualitative and quantitative analysis using HPTLC.
14	Analytical method development for three component mixture using HPTLC.
15	Calibration of HPLC instrument for flow rate & wavelength.
16	Determination of theoretical plate, HETP, resolution, tailing factor for two component ..mixture

17	Determination of caffeine content in tea/ coffee/ other beverages.
18	Quantitation using different methods such as area normalization, one point, two point method with the help of internal standard.
19	Determination of melting point & heat of fusion using DSC.
20	Determination of glass transition temperature using DSC.
21	Interpretation of ORD and CD spectrum.
Suggested List of Assignments/Tutorial : N A	

Name of the Course :Computer and Statistics		
Course code: S1-MPC-3 [T]		Semester : I
Duration : 60 Hrs[T], 60 Hrs [P]		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : 04 Hrs/week		End Semester Exam: 70 Marks
Credits : 04 Each [T & P]		
Aim :-		
Objective :-		
S. No		
1	To train students in basics of computer hardware.	
2	To train them on hands on experience in use of different software.	
3	To teach them applications of computers in different areas of Pharmacy.	
4	To train the students for applications of various statistical methods available for analysis of data.	
Pre-Requisite:-		
S. No		
1	A 10 + 2 level mathematics & rudimentary knowledge of computers.	
2	A B, Pharm. Degree from any institution approved by AICTE or its equivalent.	
Contents		Hrs
Computers		
Unit -1	Hardware: Current hardware & their performance, New devices / technology useful in teaching & research like Cameras, Scanner, touch screens, tablets, projection devices etc. Basic idea of computer networking.	03
Unit -2	Operating systems: Common operating systems used in day to day task & instrumentation like Windows, Linux & Unix (only interface and basic commands).	15
Unit -3	Language: Evolution of computer languages. Common languages used in scientific fraternity (no specific language detailing is required).	06
Unit -4	Software: Idea of popular soft ware's like MS Office, structure drawing software's, chemical structure visualizing software's, statistical software's & mathematical software, reference managing software's (only introduction).	05
Unit -5	Web page design: Need, concept and use of HTML.	08
Unit -6	Databases: Meaning, Need and creating table, record creating and maintenance.	05
Unit -7	Internet concept: History, creating internet connection, common problems & solutions.	06

Unit -8	Important Databases of free domain: Patents, Pub med, Pubchem, Science direct, protein database.	05
Statistics		
Unit -1	Data & Graphs.	03
Unit -2	Basic statistics.	02
Unit -3	Sampling.	04
Unit -4	Hypothesis testing.	06
Unit -5	Optimization.	06
Unit -6	Designing experiment.	06
Unit -7	Clinical data management.	02
Unit -8	Meta analysis.	03
Unit -9	Statistical Quality control.	05
Unit-10	Introduction to common statistical software.	03
	Total	60

Text Books:

Reference books :

- W.E. Fassett, 1986. "Computer Applications in Pharmacy", Lea & Febiger Publisher.
- C.N. Madu, 2003. "Statistics as easy as one, two, three with Microsoft Excel for Windows", 1st Ed. Chi Publishers Inc.
- A.N. Armstrong, 2006. "Pharmaceutical experimental design and interpretation", CRC/Taylor & Francis.
- G.A. Lewis, D. Mathieu, R.T. Phan, 1999. "Pharmaceutical experimental design", CRC Press.
- W.G. Cochran, W.G. Cochran, G.M. Cox, 1992. "Experimental designs". Wiley.
- <http://pages.stern.nyu.edu/~jsimonof/classes/1305/pdf/excelreg.pdf>
- www.Pubmed.com
- www.Pubchem.com
- www.mdl.com
- <http://www.vlifesciences.com>
- <http://spdbv.vital-it.ch>
- <http://www.winstat.com>
- www.uspto.gov
- www.esp.gov
- Lambert M Surhone, Miriam T Timpledon, Susan F Marseken, 2010. "Rasmol", VDM Verlag Dr. Mueller AG & Co. Kg.
- <http://www.vlifesciences.com>
- <http://spdbv.vital-it.ch>
- <http://www.winstat.com>
- Scholarships, Fellowships & Loans, Chrystal Rozs, Gale, 2002.
- **It is strongly recommended that some standard book/s be used for practicals. The choice of book/s is left to the concerned teachers.**

Suggested List of Laboratory Experiments :

S. No	
1	To understand computer hardware & their integration (computer, printer, scanner, display device, Bluetooth & IR devices).
2	To understand operating system / s.
3	To know the evolution of computer languages.
4	To design simple web page using HTML editor (Word, FrontPage etc.).
5	To make simple database using MS Access (i.e. Plant database, reference database etc.).
6	To create, editing & formatting worksheet using excel.
7	To make use of formula in excel.
8	To write macros in spreadsheet.
9	To create graphs for representing data.
10	To perform statistical operations on the obtained data.
11	To make decisions using formula in spreadsheet.
12	To develop ability to create master document in MS word.
13	To make PowerPoint presentations with hyper linking & animation effects.
14	To learn & develop expertise in use of structure drawing software like ISIS, Chem sketch etc.
15	To learn use of structure visualization software like Rasmol.
16	To visualize protein molecules using Protein explorer.
17	To learn searching internet based databases like Pub med, US Patents.
18	To develop technique for calculating molecular properties on line.
19	To perform simple optimization exercises using MS Excel / any statistics software.
Suggested List of Assignments/Tutorial : N A	

Name of the Course : Nanotechnology and Biotechnology		
Course code: S1-MPC-4 [T & P]		Semester : I
Duration : 60 Hrs [T], 120 Hrs [P]		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : 08 Hrs/week		End Semester Exam: 70 Marks
Credits : 04 Each [T & P]		
Aim :-		
Objective :-		
S. No		
1	To give basics of nanotechnology.	
2	To impart advanced level training in bio & nanotechnology with emphasis on their use in Pharmacy.	
3	To make use of this advanced level knowledge in drug discovery.	
4	To impart training on carrying out the sophisticated experiments in these areas.	
Pre-Requisite:-		
S. No		
1	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.	
Contents		Hrs
Unit -1	BIONANOTECHNOLOGY: History, opportunities and challenges of bionanotechnology, growth potential of bionanotechnology, significance of nanosize in biotechnology and medicine.	04
Unit -2	NANO-DRUG DELIVERY: Conventional delivery of biotechnologicals and its limitations, biological barriers in delivery of therapeutics, importance of nano-size in site-selective delivery. Targeted delivery of biotechnological using nanostructures, application of nanocarriers in delivery of biotechnologicals, nano-drug delivery chip.	10
Unit -3	BIONANOCARRIERS: Design and fabrications of nanocapsules, nanoliposomes, nanoparticles, nanoemulsion, nanopore technology, nano-self assembling systems, bionanoarrays, dendrimers, carbon nanotubes, nanosomes and polymersomes, inorganic nanoparticles (gold-gold colloids, gold nanofilm, gold nanorods, titanium and zinc oxide), structured DNA nanotechnology.	11
Unit -4	NANOMEDICINE, NANOBIOLOGY AND NANOBITECHNOLOGY: Synthesis and assembling of nanoparticles/nanostructures using bio-derived templates, proteins and nanoparticles, covalent and non-covalent conjugates, cantilevers array sensors for bioanalysis and diagnostics, nanowire and nanotube biomolecular sensors for <i>in-vitro</i> diagnosis of cancer and other diseases. Biologically inspired hybrid nanodevices, nanotube membranes for biotechnology, shelf-assembling of short peptides for nanotechnologicals applications.	10
Unit -5	BIONANOIMAGING: Quantum dots-luminescent semiconductor QD in cell and tissue imaging, fluoroimmunoassay using QD. Ultrasound contrast agents, magnetic nanoparticles, nanoparticles in molecular imaging, nanoforce and	08

	imaging-AFM, molecules, cells, materials and systems design based on nanobiotechnology for use in bioanalytical technology.	
Unit -6	DRUG DISCOVERY: Drug screening, technoglobalism and drug development, biodiagnostics.	02
Unit -7	chemogenomics, computational chemistry, new pharmaceuticals from marine sources, cell based therapies, encapsulated cells for disease treatment.	03
Unit -8	INSTRUMENTATION AND PRINCIPLES: Electrophoresis techniques, laser confocal microscopy, digital image analysis, biosensors in diagnostics, enzyme purification and assay techniques. Techniques in cytogenetics: DNA sequencing, DNA microarray. Spectral analysis techniques: Introduction, estimation of proteins, DNA and RNA.	08
Unit -9	SAFETY CONCERN OF BIONANOTECHNOLICALS: Inhalation, contact/dermal delivery, environmental impact, explosion hazards.	04
	Total	60

Text Books:

Reference books :

- E.S. Papazoglou and A. Parthasarathy, "Bionanotechnology". 1st Ed. Morgan and Claypool.
- N.H. Malsch. 2005. "Biomedical nanotechnology" CRC Press.
- D.S. Goodsell, 2004. "Bionanotechnology: lessons from nature" Wiley-Liss Publication.
- T. Vo-Dinh, "Nanotechnology in biology and medicine: methods, devices, and applications" CRC Press.
- V. Labhasetwar, D.L. Leslie-Pelecky, 2007. "Biomedical applications of nanotechnology". Wiley-Interscience: Hoboken.
- S.P. Vyas, S.R. Murthy and R.K. Narang, 2010. "Nanocolloidal carriers: site-specific and controlled drug delivery" CBS Publishers and Distributors.
- **It is strongly recommended that some standard book/s be used for practicals. The choice of book/s is left to the concerned teachers.**

Suggested List of Laboratory Experiments :

- Development of nanoparticles by solvent-evaporation method.
- Design of nanospheres by emulsification method.
- Preparation of polymeric nanocapsules by solvent-diffusion method.
- Evaluation of nanoparticles for particle size, zeta potential, drug entrapment efficiency, stability and other parameters.
- Development of solid lipid nano particles using various lipids.
- Preparation of nano-liposomes by solvent dispersion/film hydration method.
- Development and evaluation of nano-niosomes.
- Development and evaluation of nano-suspensions.
- Preparation of nanoemulsions by using ternary phase diagrams.
- Incorporation of nanoemulsions in topical gels.
- Evaluation of dermal retention, penetration, skin irritation and toxicity potential of nano topical formulations.
- Development of nanosponges based on cyclodextrin complexes.
- Assessment of solubility enhancement by nano formulations.
- Pegylation of nanoparticles.
- Synthesis of Al₂O₃ nanoparticles using sol-gel method.
- Synthesis of Fe₂O₃ nanoparticles by chemical method.
- Synthesis of nanoparticles using biological process (2-3 methods).
- Functionalization of nanoparticles for biological application- (4-5 methods).
- Detection of nanoparticles in colloidal solutions using UV-Visible Absorption technique size determination of nanoparticles using laser beam.

- Analysis of ANM, SEM AND TEM pictures.
- Polyacrylamide gel electrophoresis: native gel.
- Isolation and separation of secondary metabolites.
- 2-D Gel electrophoresis of proteins and isoelectrofocusing.
- Synthesis of nanometer scale particles of colloidal semiconductors such as TiO_2 , CdS , ZnO , SnO_2 , Cu_2S , CuCNS , Cu_2O , BaTiO_3 , SrTiO_3 by wet chemical methods, hydrothermal methods, and pyrolytic or high temperature methods.

Suggested List of Assignments/Tutorial : N A

Name of the Course : Research Project	
Course code: S2-MPC-1 [P]	Semester : II
Duration : 120 Hrs	Maximum Marks : 50
Teaching Scheme	Examination Scheme
Theory : Hrs/week [N A]	Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [N A]	Assignment & Quiz: Marks [N A]
Practical : 08 Hrs/week	End Semester Exam: 30 Marks
Credits : 02	
Aim :-	
Objective :-	
S. No	
1	To give exposure on how to do literature survey for the project work.
2	To develop technical writing skills in the form of a research report.
3	To develop report presentation ability, orally.
4	To develop question answer capability confidently.
Pre-Requisite:-	
S. No	
1	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.
Text Books: N A	
Reference books: Choice of books & other literature shall depend on the topic of research & the choice is left with the individual faculty.	
Suggested List of Laboratory Experiments : N A	
Suggested List of Assignments/Tutorial : N A	

Name of the Course : Advanced Pharmaceutical Chemistry – 1		
Course code: S2-MPC-2 [T & P]		Semester : II
Duration : 60 Hrs [T], 120 Hrs [P]		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam: 20 Marks
Tutorial : Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : 08 Hrs/week		End Semester Exam: 70 Marks
Credits : 04 Each [T & P]		
Aim :-		
Objective :-		
S. No		
1	To teach students the basics & applications of drug design using computer software.	
2	To impart training in handling these drug design software by means of laboratory experiments.	
3	To give latest developments in some of the therapeutically useful classes of drugs.	
4	To develop the laboratory skills by giving advanced level reactions.	
Pre-Requisite:-		
S. No		
1	At least two UG level courses in Pharm. / Med. Chem.	
2	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.	
Contents		Hrs
Unit -1	Drug design & various rational approaches to the same. Introduction to biopharmaceutical consideration in drug design.	04
Unit -2	QSAR, CADD, molecular modeling, & docking. Use of these methods in the development of fluoroquinolones, dihydropyridines & other drugs. Study of software like ISIS, Chems sketch, RASMOL, Protein Explorer etc for structure drawing & visualization.	10
Unit -3	Prodrugs.	11
Unit -4	Recent advances in enzyme inhibitors.	10
Unit -5	Recent advances in drugs used in the treatment of: a] cancer, b] AIDS, c] cardiovascular disorders, d] diabetes, e] hepatitis, and f] immunosuppression.	08
Unit -6	Recent advances in the area of lipid / cholesterol lowering agents.	02
Unit -7	Antisense drugs & gene therapy.	03

Text Books:**Reference books :**

- J. H. Block & J. M. Beale, "Wilson & Giswold's Text Book of Organic Medicinal & Pharmaceutical Chemistry", Lippincott Williams & Wilkins, Baltimore, U. S. A
- T. L. Lemke & D. A. Williams, "Foye's Principles of Medicinal Chemistry", Lippincott Williams & Wilkins, Baltimore, U. S. A.
- R. B. Silverman, "The Organic Chemistry of Drug design & Drug Action". Academic Press, Massachusetts, U.S. A.
- Corwin Hansch, Peter George Sammes, John Bodenhan Taylor, 1990. "Comprehensive Medicinal Chemistry". Pergamon Press,
- Corwin Hansch, Albert Leo, D. H. Hoekman, 1995. "Exploring QSAR: Fundamentals and applications in chemistry and biology". American Chemical Society.
- Alfred Burger, Manfred E. Wolff, "Burger's Medicinal Chemistry and Drug Discovery: Therapeutic agents". Wiley.
- <http://pages.stern.nyu.edu/~jsimonof/classes/1305/pdf/excelreg.pdf>
- www.Pubmed.com
- www.Pubchem.com
- www.mdl.com
- <http://www.vlifesciences.com>
- <http://spdbv.vital-it.ch>
- <http://www.winstat.com>
- <http://www.organic-chemistry.org/prog/peo/cLogP.html>
- <http://intro.bio.umb.edu/111-112/OLLM/111F98/newclogp.html>
- <http://pd-beta.rcsb.org/pdb/home/home.do>
- **It is strongly recommended that some standard book/s be used for practicals. The choice of book/s is left to the concerned teachers.**

Suggested List of Laboratory Experiments :

- Drawing, editing and cleaning structure
- Structure optimization using molecular mechanical & semiempirical method
- Creating function library
- Visualization
- Changing display style
- 2D & 3D rotation of structure
- Quarrying geometry
- Calculating structural parameters
- Calculating descriptors
- Creating worksheet
- Calculating correlation
- Building regression model
- Predicting activity
- Protein file downloading
- Protein molecule visualization & querying
- Performing simple Docking
- Birch reduction
- Wolff-Kishner reduction
- Grignard reaction
- Synthesis of appropriate prodrug of aspirin/ salicylic acid

Suggested List of Assignments/Tutorial : N A

Name of the Course : Advanced Organic Chemistry		
Course code: S2-MPC-3[T],120 Hrs [P]		Semester : II
Duration : 60 Hrs		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam : 20 Marks
Tutorial: Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : 08 Hrs/week		End Semester Exam: 70 Marks
Credits : 04 Each [T & P]		
Aim :-		
Objective :-		
S. No		
1	To teach different protecting groups used in synthesis & their applications.	
2	To provide advanced level knowledge in the area of stereochemistry, novel reagents, novel reactions, etc.	
3	To impart advanced level training in carbonyl chemistry such as asymmetric enolate anions formation & their applications in asymmetric synthesis.	
4	To give hands on training on the use of various reactive reagents & the necessary safety precautions.	
Pre-Requisite:-		
S. No		
1	At least two UG level courses in Organic Chemistry & practicals of the same.	
Contents		Hrs
Unit -1	Protective groups for -OH, -NH ₂ , -COOH. Special protective groups for aldehydes / ketones such as oxazolines[A. I. Meyer's reagent] & 1,3- dithianes. Methods for the deprotection of the above groups. Concept of "Umplong". Reactions of 1,3-dithiane.	06
Unit -2	Nomenclature & stereochemistry of spiro- compounds. Stereochemistry of allenes & biphenyls.	03
Unit -3	Oxidations using Cr, Mn, Os, Ru, periodate, & Se reagents.	05
Unit -4	Homogeneous & heterogeneous reductions / hydrogenations. Metal - ammonia / amines reductions.	04
Unit -5	Preparation & reactions of P, S, & N ylides.	02
Unit -6	Fluorinating agents & their use in drug synthesis.	02
Unit -7	Preparation & use of boron reagents in asymmetric drug synthesis.	04
Unit -8	Regio- & stereoselective & stereospecific formation of enolate anions, their nucleophilic addition reactions. Role of Li, Na, K, Mg, & B metal ions in the regio- & stereoselective & reospecific formation of enolate anions.	06
Unit -9	Kinetic Vs thermodynamic alkylations of carbonyl derivatives.	02
Unit -10	Chemistry of active methylene compounds.	05
Unit -11	Different methods for the preparation of α -methylene lactones & similar functionalities.	02

Unit -12	General approaches towards peptide synthesis & solid phase synthesis.	02
Unit -13	Connection & disconnection approaches in drug synthesis.	02
Unit -14	Stereochemistry & its importance in medicinal chemistry. Methods for resolution of racemic mixtures.	01
Unit -15	Dynamic stereochemistry, conformations & reactivity in open chain & cyclic systems. Weinstein, Curtin – Hammett principle. Cram's rule & Prelog modification. Topicity & its significance in dynamic stereochemistry.	08
Unit -16	Pericyclic reactions. HOMO & LUMO. Conservation of orbital symmetry. Woodward rules for allowed & disallowed motions. Stereo specificity of these reactions.	06
	Total	60

Text Books:

Name of Authors	Titles of the Book	Edition	Name of the Publisher
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Reference books :

- R. T. Morrison & R. N. Boyd, "Organic Chemistry". Allyn & Bacon, Inc., Boston, U. S. A.
- H. O. House, W. A. Benjamin, "Modern synthetic Reactions". , Inc., Menlo Park, California, U. S. A.
- E. L. Eliel, "Stereochemistry of Carbon Compounds", McGraw-Hill Book Company, Inc., New York, U. S. A.
- D. Nassipuri, "Stereochemistry of Organic Compounds". Wiley Eastern Limited, New Delhi, India.
- M. B. Smith, "Organic Synthesis", McGraw-Hill, Inc., New York, U. S. A.
- I. L. Finar, "Organic Chemistry", ELBS Series. Longman Publishers, London.
- **It is strongly recommended that some standard book/s be used for practicals. The choice of book/s is left to the concerned teachers.**

Suggested List of Laboratory Experiments :

- Birch reduction.
- Lithium aluminum hydride reduction.
- Sodium borohydride reduction.
- Epoxidation of conjugated and non-conjugated double bonds .
- Oxidation of sulphide to sulfoxides and sulfones with hydrogen peroxide & peracid.
- Preparation of Wittig reagent & reaction with aldehyde and ketone.
- Resolution of a acidic and basic racemic mixture by diastereomer formation.
- Kinetic resolution of racemic mixture by biochemical transformation.
- Synthesis of thiazide & hydrothiazide derivative in a multistep process.
- Diel's Alder reaction for preparing bicyclo [2.2.1] system.
- Synthesis of any tripeptide from amino acids.

Suggested List of Assignments/Tutorial : N A

Name of the Course : Elective – 1	
Course code: S2-MPC-4 [T]	Semester : II
Duration : 60 Hrs [T]	Maximum Marks : 100
Teaching Scheme	Examination Scheme
Theory : 04 Hrs/week	Mid Semester Exam: 20 Marks

Tutorial: Hrs/week [N A]		Assignment & Quiz: 10 Marks
Practical : Hrs/week [N A]		End Semester Exam: 70 Markss
Credits : 04		
Aim :-		
Objective :-		
S. No.		
1	To give additional knowledge to students based on their choice of topics.	
Pre-Requisite:-		
S. No.		
1	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.	
Contents		Hrs
Unit -1	Chemo informatics.	
Unit -2	Analysis of recombinant proteins.	
Unit -3	Bioinformatics.	
Unit -4	Microwave assisted synthesis.	
Unit -5	Green chemistry.	
Unit -6	Supramolecular chemistry & its importance in pharmacy.	
	Total	60
Text Books: N A		
Reference books: The choice of literature is left to the concerned teacher depending on the selected topic.		

Name of the Course :Drug Regulatory Aspect and IPR		
Course code: S3-MPC-1 [T]		Semester : III
Duration : 60 Hrs		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [N A]		Assignment & Quiz: 10 Marks
Practical : Hrs/week [N A]		End Semester Exam: 70 Marks
Credits : 04		
Aim :-		
Objective:-		
S. No		
1	To impart information on various drug regulatory aspects involved in the profession.	
2	To teach the import / export related regulations with respect to some countries.	
3	To make the students understand the importance & implications of IPR & related matters.	
4	To train the students in GMP & the latest developments there.	
Pre-Requisite:-		
S. No		
1	A course at UG level regarding regulatory aspects, law governing Pharmacy profession.	
2	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.	
Contents		Hrs
Unit -1	DRUG REGULATORY ASPESTS	40
(a)	Drug Regulatory Aspects (India) – 1. Indian drug regulatory authorities, Central and State regulatory bodies (FDA). 2. Drugs and Cosmetics Act and Rules with latest Amendments (selective). 3. Special emphasis – Schedule M and Y. 4. New Drugs – Importation, Registration, development, clinical trials, BE NOC & B.E. studies. 5. Various licenses – Test lic., Import lic. for testing of drugs and API's, Mfg., Contract and Loan license manufacturing.	10
(b)	Good Manufacturing Practices (GMP) – 1. Indian GMP certification, WHO GMP certification. 2. ICH guidelines for stability testing and other relevant ones (Q1 – Q10). 3. Export permissions and manufacturing for semi-regulated countries. 4. Understanding of the plant lay-outs with special emphasis on the environment & safety. (HVAC, water systems, stores management, effluent etc.). 5. Quality Assurance and Quality Control – Basic understanding for in-built quality.	12
(c)	Drug Regulatory Aspects (International & highly regulated markets) – 1. US Requirements – (for Generic Drugs especially formulations).	18

	<p>2. CDER, INDA, NDA, ANDA's (types), CTD Formats of dossiers, E-submission, US DMF (various types), IIG Limits, Orphan Drugs, vanilla ANDA's, exhibit/pivotal batches, validation batches, various guidance issued by CDER, OGD, Orange Book (and patents), RLD (reference listed drug) for BE studies and the norms for US submission, bioequivalence and dissolution recommendations, packaging, stability studies and the product information leaflet, US FDA inspection (audits), pre-approval inspections and approvals.</p> <p>3. European Union Requirements –</p> <p>4. All the aspects for European registration of formulations for generic drugs sale in the European markets under EU. EMEA guidelines on various aspects as above (C 1).</p> <p>5. A brief introduction to the guidelines for Japan, Australia, South Africa, Rest of the World (ROW) and South & Latin American countries.</p> <p>6. GMP audits, role of quality assurance, product approvals and supplies.</p>	
Unit -2	INTELLECTUAL PROPERTY RIGHTS (IPR)	20
(a)	Introduction to IPR & Patents – Development of IP law in India, IPR regime, introduction to IP laws in India, role of IP in pharma industry growth.	
(b)	Patenting in India – Introduction, patent legislation, Indian Patents Act 1970 and amendments, procedure for patent application, grant and opposition proceedings, patent licensing, patent infringement proceedings, IPAB – role and functions (IP Appellate Board), Indian IP case laws.	
(c)	American & European patent system – Requirements for patenting, utility, novelty non-obviousness, patent specification & claims, patent infringement and doctrine of equivalents, federal circuit and patent system in Europe.	
(d)	International treaties and conventions on IPR - Paris convention, PCT – an introduction, PCT application & general rules, WTO / GATT system & Uruguay TRIPS, WIPO.	
(e)	Hatch Waxman Act and amendments, FDA Medicare Modernization Act, 2003.	
(f)	Introduction to geographical indication / trademark/ copyright; filing procedures.	
(g)	Patent search, patent analysis & patent drafting.	
(h)	Allied Patents Related Issues: Exploitation of patent, abuse of patents, compulsory licensing, infringement analysis, drug-patent linkage.	
Text Books:		
Reference books :		
<ul style="list-style-type: none"> • CDSO publications and updates of drug and Cosmetics act and rules (Govt. of India). • CDER Publications and Guidance • EMEA Publications and Guidance • Orange Book, ICH guidelines, Indian Patents Act • Country specific Regulatory Guidelines (available from internet) • Govt. Publications on issues affecting sales, distribution, manufacturing, excise, etc. • J. D. Nally, "Good manufacturing Practice for Pharmaceuticals" Informa Healthcare. • I. Kanfer & L. Shargel, "Generic Product Development BE issued" Informa Healthcare. • R. A. Guarino, "New Drug Approval Process. The Global challenges". Informa Healthcare. • Watcher and Nash, "Pharmaceutical Process Validation". Marcel Dekker. • Pharmaceutical Product Dev. IVIVC by Murthy, Sunkara and David • USPTO and WIPO Guidelines, Indian Patents Act 		
Suggested List of Laboratory Experiments : N A		

Suggested List of Assignments/Tutorial : N A

Name of the Course : Research Work Seminar	
Course code: S3-MPC-2 [P]	Semester : III
Duration : 120 Hrs	Maximum Marks : 100
Teaching Scheme	Examination Scheme
Theory : Hrs/week [N A]	Mid Semester Exam: 30 Marks
Tutorial: Hrs/week [NA]	Assignment & Quiz: Marks [N A]
Practical : 08 Hrs/week	End Semester Exam: 70 Marks
Credits : 04	
Aim :-	
Objective :-	
S. No	
1	To effectively present the research work carried out by the student.
Pre-Requisite:-	
S. No	
1	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.
Text Books: N A	
Reference books: The choice of books & other literature material depends on the topic selected & is left with the concerned faculty member.	
Suggested List of Laboratory Experiments : N A	
Suggested List of Assignments/Tutorial : N A	

Name of the Course : Research Project	
Course code: S3-MPC-3 [P]	Semester : III
Duration : 240 Hrs	Maximum Marks : 150
Teaching Scheme	Examination Scheme
Theory : Hrs/week [N A]	Mid Semester Exam: Marks [N A]
Tutorial: Hrs/week [N A]	Assignment & Quiz: Marks [N A]
Practical : 16 Hrs/week	End Semester Exam: 150 Marks
Credits : 06	
Aim :-	
Objective :-	
S. No	
1	To manage the research work in time bound manner.
Pre-Requisite:-	
S. No	
1	A B. Pharm. degree from any institution approved by AICTE or its equivalent.
Text Books: N A	
Reference books : N A	
Suggested List of Laboratory Experiments : N A	
Suggested List of Assignments/Tutorial : N A	

Name of the Course : Advanced Pharmaceutical Chemistry – 2		
Course code: S3-MPC-4 [T]		Semester : III
Duration : 60 Hrs		Maximum Marks : 100
Teaching Scheme		Examination Scheme
Theory : 04 Hrs/week		Mid Semester Exam: 20 Marks
Tutorial : Hrs/week [If required]		Assignment & Quiz: 10 Marks
Practical : Hrs/week [N A]		End Semester Exam: 70 Marks
Credits : 04		
Aim :-		
Objective :-		
S. No		
1	To give detailed coverage of the following topics, including chemistry, biochemistry & pharmacology involved should be given.	
2	To provide latest knowledge on the topics mentioned in the units.	
3	To train the students in basic & newer approaches in synthesis of drug molecules / chemical entities.	
4	To expose the students on methodologies in synthesizing complex biologically active molecules.	
Pre-Requisite:-		
S. No		
1	At least two courses at UG level & an advanced level course in organic chemistry at PG level.	
2	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.	
Contents		Hrs
Unit-1	Antibiotics & drug resistance. Monobactam antibiotics. General approaches for their preparation. Asymmetric synthesis of thienamycin & aztreonam.	06
Unit-2	Endogenous opioids.	05
Unit-3	Methods used in the synthesis of glycosides, nucleosides, & nucleotides.	06
Unit-4	Synthetic methodology / approaches to the synthesis of bicyclo [4.3.2], [3.2.1], [2.2.2], & [2.2.1] systems. This should be illustrated by the synthesis of appropriate drug molecules like mecamlamine, atropine, scopolamine etc.	05
Unit-5	Preparation of recombinant insulin, γ - interferon, & streptokinase.	06
Unit-6	Biosynthesis of cholesterol, estrogen & progesterone from acetate. Biomimetic synthesis of steroids, illustration of Prof. W. S. Johnson's synthesis	05
Unit-7	Chiral technology in drug synthesis. Asymmetric synthesis of drugs like propranolol, metoprolol, naproxen, vit. C, using asymmetric epoxidations, asymmetric reductions / hydrogenations, asymmetric enzymatic / bacterial biotransformations. Illustration of 1 st , 2 nd , 3 rd , & 4 th generation methods of asymmetric synthesis giving one example each.	11
Unit-8	Total synthesis of the following drug molecules: A] Reserpine [Prof. Woodward's synthesis]. B] Progesterone from diosgenin. C] Stanazolol. D] Emetine. E] Quinine. F] Prostaglandins F and E [Profs. Corey, Stork & Sih's methods].	16
	Total	60
Text Books:		

Reference books :

- J. H. Block & J. M. Beale, "Wilson & Giswold's Text Book of Organic Medicinal & Pharmaceutical Chemistry", Lippincott Williams & Wilkins, Baltimore, U. S. A
 - T. L. Lemke & D. A. Williams, "Foye's Principles of Medicinal Chemistry", Lippincott Williams & Wilkins, Baltimore, U. S. A.
 - R. B. Silverman, "The Organic Chemistry of Drug design & Drug Action" Academic Press, Massachusetts, U.S. A.
 - Triger and Taylor, "Comprehensive Medicinal Chemistry". All Volumes. 1st Ed. Elsevier Science.
 - C. Hansch,
 - Burger. "Medicinal Chemistry". All volumes. Interscience Publishers, Inc., New York-London.
 - H. O. House, W. A. Benjamin, "Modern synthetic Reactions". Menlo Park, California, U. S. A.
 - J. D. Morrison, "Asymmetric Synthesis" vols. 1 – 5. Academic Press, Orlando,
 - U. S. A.
 - R. A. Aitken & S. N. Kilenyi, "Asymmetric Synthesis" Edited by, Blackie Academic & Professional, An imprint of Chapman & Hall, London, U. K.
 - R. A. Sheldon, "Chirotechnology, Industrial Synthesis of Optically Active Compounds". Marcel Dekker, Inc., New York, U. S. A.
 - R. Porter, & S. Clark, "Enzymes in Organic Synthesis" Pitman, London, U. K.
- G. W. Moody, P. B. Baker, "Bioreactors & Biotransformations". Elsevier, Amsterdam

Suggested List of Laboratory Experiments : N A**Suggested List of Assignments/Tutorial : N A**

Name of the Course : Elective – 2	
Course code: S3-MPC-5 [T]	Semester : III
Duration : 60 Hrs	Maximum Marks : 100
Teaching Scheme	Examination Scheme
Theory : 04 Hrs/week	Mid Semester Exam: 20 Marks
Tutorial: Hrs/week [N A]	Assignment & Quiz: 10 Marks
Practical : Hrs/week [N A]	End Semester Exam: 70 Marks
Credits : 04	
Aim :-	
Objective :-	
S. No	
1	To enrich the knowledge of a student desirous of studying special topic / s of interest.
Pre-Requisite:-	
S. No	
1	A B. Pharm. Degree from any institution approved by AICTE or its equivalent.
Contents	
	Hrs
Unit-1	Chiral synthons.
Unit-2	Screening models for anticancer drugs.
Unit-3	Ultra pressure liquid chromatography & Overpressure liquid chromatography.
Unit-4	Receptor isolation.
Unit-5	Special reagents in organic chemistry.
Unit-6	Combinatorial chemistry.
	Total
	60
Text Books: N A	
Reference books: The choice is discretionary depending on the selected topic.	
Suggested List of Laboratory Experiments : N A	
Suggested List of Assignments/Tutorial : N A	

Name of the Course :Research Project and Colloquium	
Course code: S4-MPC-1 [P]	Semester : IV
Duration : 540 Hrs	Maximum Marks : 400
Teaching Scheme	Examination Scheme
Theory : Hrs/week [N A]	Mid Semester Exam: Marks [N A]
Tutorial: Hrs/week [N A]	Assignment & Quiz: Marks [N A]
Practical : 36 Hrs/week	End Semester Exam: 400 Marks
Credits : 16	
Aim :-	
Objective :-	
S. No	
1	To complete the given research project.
2	To effectively defend the work before a group of qualified evaluators.
Pre-Requisite:-	
S. No	
1	A B. Pharm. degree from any institution approved by AICTE or its equivalent.
Text Books: N A	
Reference books: It is left at the discretion of the teacher depending on the topic selected.	
Suggested List of Laboratory Experiments : N A	
Suggested List of Assignments/Tutorial : N A	