

# **COURSE CURRICULUM UNDER CHOICE BASED CREDIT SYSTEM (C.B.C.S.)**

**SYLLABUS**

**FOR**

**Masters of Science (M.Sc) in CHEMISTRY**

**(w.e.f. Academic Session: 2021-2022)**



**Department of Chemistry**

(Faculty of Science & Technology)

Aliah University

IIA/27, Newtown, Kolkata 700160, West Bengal, India

### Semester Wise Course Distribution for Department of Chemistry

	Semester I	Semester II	Semester III	Semester IV
CCT	CHMPGCCT01 CHMPGCCT02 CHMPGCCT03 CHMPGCCT04	CHMPGCCT05 CHMPGCCT06 CHMPGCCT07 CHMPGCCT08	CHMPGCCT09/ CHMPGCCT10	CHMPGCCT11/ CHMPGCCT12
CCP	CHMPGCCP01	CHMPGCCP02	CHMPGCCP03/ CHMPGCCP04	
DET			CHMPGDET01/ CHMPGDET02	CHMPGDET03/ CHMPGDET04
DEP			CHMPGDEP01/ CHMPGDEP02	CHMPGDEP03/ CHMPGDEP04
GEC			CHMPGGEC01/ CHMPGGEC02	CHMPGGEC03/ CHMPGGEC04
PRJ				CHMPGPRJ01
AUC	PGAUC01			
AEC		PGAEC01		
<b>Papers/Semester</b>	6	6	5	5
CCT	$4 \times 4 = 16$	$4 \times 4 = 16$	$1 \times 4 = 04$	$1 \times 4 = 04$
CCP	$1 \times 4 = 04$	$1 \times 4 = 04$	$1 \times 4 = 04$	$0 \times 0 = 00$
DET	$0 \times 0 = 00$	$0 \times 0 = 00$	$1 \times 4 = 04$	$1 \times 4 = 04$
DEP	$0 \times 0 = 00$	$0 \times 0 = 00$	$1 \times 4 = 04$	$1 \times 4 = 04$
GEC	$0 \times 0 = 00$	$0 \times 0 = 00$	$1 \times 4 = 04$	$1 \times 4 = 04$
PRJ	$0 \times 0 = 00$	$0 \times 0 = 00$	$0 \times 0 = 00$	$1 \times 4 = 04$
AUC	$1 \times 0 = 00$	$0 \times 0 = 00$	$0 \times 0 = 00$	$0 \times 0 = 00$
AEC	$0 \times 0 = 00$	$1 \times 0 = 00$	$0 \times 0 = 00$	$0 \times 0 = 00$
<b>Credits/Semester</b>	20	20	20	20

\*Core Course Theory (CCT) and Core Course Practical (CCP), Discipline Specific Elective Course Theory (DET), Discipline Specific Elective Course Practical (DEP), Generic Elective Course (GEC), Project and Dissertation (PRJ), Aliah University Compulsory Course (AUC), Ability Enhancement Compulsory Course (AEC)

## Syllabus Structure for Department of Chemistry

### Semester-I

Course Title	Course Code	Credits	Marks
Inorganic Chemistry	CHMPGCCT01	4	50
Organic Chemistry	CHMPGCCT02	4	50
Physical Chemistry	CHMPGCCT03	4	50
Analytical Chemistry	CHMPGCCT04	4	50
Chemistry Practical-I	CHMPGCCP01	4	50
Elementary Arabic and Islamic Studies	PGAUC01	Non-Credit	
		20	250

\*Core Course Theory (CCT), Core Course Practical (CCP) and Aliah University Compulsory Course (AUC)

### Semester-II

Course Title	Course Code	Credits	Marks
Biochemistry and Basic Immunology	CHMPGCCT05	4	50
Spectroscopy	CHMPGCCT06	4	50
Medicinal Chemistry- I	CHMPGCCT07	4	50
Chemistry of Natural Products	CHMPGCCT08	4	50
Chemistry Practical-II	CHMPGCCP02	4	50
Disaster Management/ Human Rights & Value Education/Yoga & Life Skills (Any one of the above)	PGAEC01	Non-Credit	
		20	250

\*Core Course Theory (CCT), Core Course Practical (CCP) and Ability Enhancement Compulsory Course (AEC)

### Semester-III

#### A) Core Course

##### Medicinal Chemistry Specialization

Course Title	Course Code	Credits	Marks
Medicinal Chemistry-II	CHMPGCCT09	4	50
Chemistry Practical-III	CHMPGCCP03	4	50
		8	100

\*Core Course Theory (CCT) and Core Course Practical (CCP)

##### Organic Chemistry Specialization

Course Title	Course Code	Credits	Marks
Heterocyclic Chemistry	CHMPGCCT10	4	50
Chemistry Practical-IV	CHMPGCCP04	4	50
		8	100

\*Core Course Theory (CCT) and Core Course Practical (CCP)

#### B) Discipline Specific Elective Course Theory (DET) [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Microbiology	CHMPGDET01	4	50
Advanced Stereochemistry	CHMPGDET02	4	50
		4	50

#### C) Discipline Specific Elective Course Practical (DEP) [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Chemistry Practical-V	CHMPGDEP01	4	50
Chemistry Practical-VI	CHMPGDEP02	4	50
		4	50

#### D) Generic Elective Course (GEC) [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Herbal Medicine	CHMPGGEC01	4	50
Chemistry of Reagents	CHMPGGEC02	4	50
		4	50

## Semester-IV

### A) Core Course

#### Medicinal Chemistry Specialization

Course Title	Course Code	Credits	Marks
Basic Pharmacology and Drug Delivery	CHMPGCCT11	4	50
		4	50

\*Core Course Theory (CCT)

#### Organic Chemistry Specialization

Course Title	Course Code	Credits	Marks
Pharmaceutical Chemistry	CHMPGCCT12	4	50
		4	50

\*Core Course Theory (CCT)

### B) Discipline Specific Elective Course Theory (DET) [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Industrial Pharmacy	CHMPGDET03	4	50
Applied Organic Chemistry	CHMPGDET04	4	50
		4	50

### C) Discipline Specific Elective Course Practical (DEP) [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Chemistry Practical-VII	CHMPGDEP03	4	50
Chemistry Practical-VIII	CHMPGDEP04	4	50
		4	50

### D) Generic Elective Course (GEC) [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Pharmacokinetics and Pharmacodynamics	CHMPGGEC03	4	50
Bioorganic Chemistry	CHMPGGEC04	4	50
		4	50

### E) Project and Dissertation (PRJ)

Course Title	Course Code	Credits	Marks
Project and Dissertation	CHMPGPRJ01	4	50
		4	50

## Detailed Syllabus

### Semester-I

Course Title	Course Code	Credits	Marks
Inorganic Chemistry	CHMPGCCT01	4	50
<b>Unit-I Chemical application of group theory</b>			
Symmetry. Symmetry elements and symmetry operations. Point groups. Introduction to character tables. Uses of character tables.			
<b>Unit-II Chemistry of cluster compounds and macrocycles</b>			
Structure and bonding in polyhedral boranes and carboranes, <i>styx</i> notation; Wade's rule; electron count in polyhedral boranes; synthesis and reactions of polyhedral boranes. Synthesis and structure of crown ethers, cryptands, calixarenes, cyclodextrins, cyclophanes, cryptophanes, catenanes and rotaxanes. Host-Guest interactions, lock and key analogy.			
<b>Reference Books:</b>			
<ol style="list-style-type: none"><li>1. F. A. Cotton, Chemical Applications of Group Theory, Wiley, 1996.</li><li>2. Carter, R. L., Molecular Symmetry and Group Theory, John Wiley and Sons, 3rd Edn., 1998.</li><li>3. K. V. Reddy, Symmetry and spectroscopy of molecules, New Age International (P) Ltd. Publishers, 2<sup>nd</sup> Edition 2009.</li><li>4. R. Ameta, Symmetry and Group Theory in Chemistry, New Age International (P) Ltd. Publishers, 1st Edition 2013.</li><li>5. N. N. Greenwood and E. A. Earnshaw; Chemistry of elements, Second Edition, Butterworth- Heinemann, 1997.</li><li>6. T. P. Fehlner, J. F. Halet and J-Y. Saillard; Molecular Clusters: A Bridge to solid-state Chemistry, Cambridge University press, 2007.</li><li>7. J.-M. Lehn; Supramolecular Chemistry-Concepts and Perspectives (Wiley-VCH, 1995).</li><li>8. P. D. Beer, P. A. Gale, D. K. Smith; Supramolecular Chemistry (Oxford University Press, 1999)</li><li>9. J. W. Steed and J. L. Atwood; Supramolecular Chemistry (Wiley, 2000).</li><li>10. A. K. Das; Fundamental Concepts of Inorganic Chemistry, CBS</li></ol>			

Course Title	Course Code	Credits	Marks
Organic Chemistry	CHMPGCCT02	4	50
<b>Unit-I: <i>Pericyclic reactions</i></b>			
<p>Molecular orbitals: MOs of acyclic and cyclic polyenes and arenes. FMO. Role of FMO in organic reactions.</p> <p>Pericyclic reactions: Classification of pericyclic reactions. Thermal and photochemical reactions. Four approaches: Conservation of orbital symmetry and correlation diagram, Frontier molecular orbital approach [FMO] and Aromatic (Huckel and Mobius) transition state approach, Woodward-Hoffmann rules.</p> <p>Cycloaddition reactions: <math>4n</math> and <math>(4n+2)</math> <math>\pi</math> electron systems. Diels-Alder reactions, Cycloreversion, 1,3-Dipolar cycloadditions and cheletropic reactions.</p> <p>Electrocyclic reactions: Conrotatory and disrotatory motions, <math>4n</math> and <math>(4n+2)</math> <math>\pi</math> electron systems and other systems. Valence tautomerism.</p> <p>Sigmatropic rearrangements: H-shifts and alkyl-shifts, supra and antarafacial migrations. Cope and Claisen rearrangements. Degenerate Cope rearrangement, Fluxional tautomerism. Wittig rearrangement, 2,3-sigmatropic shifts.</p> <p>Group Transfer reaction: the ene reactions.</p>			
<b>Unit-II: <i>Photochemistry of Organic molecules</i></b>			
<p>Photochemical reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy.</p> <p>Types of photochemical reactions-photo dissociation, gas-phase photolysis.</p> <p>Photochemistry of alkenes: Intramolecular reactions of the olefinic bond –cis-trans isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.</p> <p>Photochemistry of carbonyl compounds: Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, <math>\beta,\gamma</math>-unsaturated and <math>\alpha</math>, <math>\beta</math>-unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions-dimerisations and oxetane formation.</p> <p>Photochemistry of aromatic compounds: Isomerisations, additions and substitutions.</p> <p>Miscellaneous photochemical reactions: Photo-Fries reaction of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular Oxygen reaction. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.</p>			
<b>Reference Books:</b>			
1. Photochemistry and Pericyclic Reactions- Jagadamba singh			

2. Pericyclic Reactions - A Textbook: Reactions, Applications and Theory- S. Sankararaman, Roald Hoffmann
3. Advanced Organic Chemistry-Jerry march
4. Advanced Organic Chemistry- Carey and Sandberg
5. Aspects of Organic Photochemistry-W. M. Horspoot
6. Organic Photochemistry- J. Coxon and B Halton
7. Pericyclic reactions- S.M Mukherji

Course Title	Course Code	Credits	Marks
Physical Chemistry	CHMPGCCT03	4	50
<b>Unit-I: <i>Quantum Chemistry</i></b>			
<p>Simple Harmonic Oscillator: setting up of the Schrodinger stationary equation, energy expression (without derivation), expression of wave function for <math>n = 0</math> and <math>n = 1</math> (without derivation) and their characteristic features, Stationary Schrodinger equation for the H-atom in polar coordinates, separation of radial and angular (<math>\theta, \phi</math>) parts. Solution of <math>\phi</math>-part and emergence of quantum number 'm'; energy expression (without derivation), degeneracy. Hydrogenic wave functions up to <math>n = 2</math> (expression only); real wave function. Concept of orbitals and shapes of s and p orbitals. Approximate methods in quantum mechanics, variational principle, Hückel Theory and its applications, Perturbation theory, first order non-degenerate and degenerate perturbation theory and applications.</p>			
<b>Unit II: <i>Statistical thermodynamics</i></b>			
<p>Macrostates and microstates, thermodynamic probability, entropy and probability, Boltzmann distribution formula (with derivation). Applications to barometric distribution. Partition function and Einstein's theory of heat capacity of solids. Limitations of Einstein's theory and Debye's modification (qualitative). Nernst heat theorem. Approach to zero kelvin, adiabatic demagnetisation. Planck's formulation of third law and absolute entropies.</p>			
<b>Unit III: <i>Polymer Chemistry</i></b>			
<p>Basic concepts of polymer science, Degree of polymerization, classification of polymers based on source, composition, structure, mode of polymerization, molecular forces, tacticity; types of polymerization: condensation or step polymerization, chain polymerization, coordination polymerization, molecular mass of polymer. plastics, biopolymers, conducting polymers, molecular forces and chemical bonding in polymers,</p>			



Copolymerization - Kinetics of copolymerization, the copolymer equation, monomer reactivity ratios, instantaneous composition of polymer.

**Reference Books:**

1. Physical Chemistry : A Molecular Approach – D.A. McQuarrie, J.D. Simon
2. Quantum Mechanics-J. L. Powell, B. Crasemann
3. Quantum Chemistry – I. N. Levine

Course Title	Course Code	Credits	Marks
Analytical Chemistry	CHMPGCCT04	4	50

**Unit-I: *Separation by solvent extraction and distillation methods***

Extraction methods and theory, distribution law, partition coefficient, the distribution ratio, the percent extraction, types of extraction procedures, simple extraction, exhaustive or continuous extraction, counter current extraction, application of extraction-procedure, inorganic separation. Examples of solvent extraction equilibria, partition of a weak acid, extraction of a metal as chelate compounds, extraction systems involving ion pairs and solvates, problems. Basic principles of distillation, concept of volatility, theory of fractional distillation, idea of theoretical plates and HETP, separation of some species by distillation, problems.

**Unit II: *Chromatographic Separations***

Basic principles, theory, theoretical plates, the Van Deemter equation, diffusion processes, resolution, separation factor, retention factor, distribution coefficient, effect of temperature, column chromatography, paper chromatography, thin layer chromatography, HPLC, affinity chromatography, gas chromatography.

**Unit III: *Principle and application of titrimetric and gravimetric analysis***

Complexometric analysis, effect of pH, indicators' range, gravimetric analysis.

**Unit IV: *Instrumental analysis***

Basic principles and application of the followings:

Thermal method-TGA, DTA, DSC, Polarimetry, Coulometric analysis, voltammetric analysis, flame photometry, atomic absorption spectroscopy, atomic emission spectroscopy.

**Reference Books:**

1. Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch.

2. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch.
3. Instrumental Analysis by Douglas A. Skoog, F. James Holler and Stanley R. Crouch.
4. Textbook of Practical organic Chemistry by Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith and Austin R. Tatchell.

Course Title	Course Code	Credits	Marks
Chemistry Practical-I	CHMPGCCP01	4	50
<b>Unit-I: Qualitative Analysis of organic compounds</b>			
Separation, purification and identification of the mixture of two organic compounds.			
<b>Unit-II: Determination of physical parameters</b>			
1. Verification of Beer-Lambert's law with a given solution and the determination of the concentration of a solution.			
2. Determination of pK <sub>a</sub> values of weak monobasic, dibasic and polybasic acid by pH metric method.			
<b>Unit-III: Synthesis and characterization of metal complexes</b>			
1. Preparation of hexamine nickel (II) chloride and estimation of ammonia and nickel by titrimetric and gravimetric methods.			
2. Synthesis, isolation and spectroscopic characterization of the complexes of transition metal acetyl acetonates.			
<b>Unit-IV: Quantitative analysis</b>			
1. Gravimetric estimation of ions (copper and PO <sub>4</sub> <sup>3-</sup> ).			
2. Determination of dissolved oxygen in pond water.			
<b>Reference Books:</b>			
1. Vogel's Textbook of Practical Organic Chemistry: A. I. Vogel, B. S. Furniss, P. W. Smith			
2. Practical Chemistry: Prof. S. Dutta.			
3. A Textbook On Chemistry Practical: Bidhan Chandra Ray, Satyanarayan Das			

## Semester-II

Course Title	Course Code	Credits	Marks
<b>Biochemistry and Basic Immunology</b>	<b>CHMPGCCT05</b>	<b>4</b>	<b>50</b>
<b>Unit-I: <i>Organization of life</i></b>			
<p>Importance of water. Cell structure and organelles. Biochemical separation techniques and characterization: ion exchange, size exclusion and affinity chromatography, electrophoresis, UV-visible, fluorescence and Mass spectrometry. Protein structure, folding and function: Myoglobin, Hemoglobin, Lysozyme, Ribonuclease A, Carboxypeptidase and Chymotrypsin. Enzyme kinetics including its regulation and inhibition, Vitamins and Coenzymes.</p>			
<b>Unit-II: <i>Metabolism and bioenergetics</i></b>			
<p>Generation and utilization of ATP. Metabolic pathways and their regulation: glycolysis, TCA cycle, pentose phosphate pathway, oxidative phosphorylation, gluconeogenesis, glycogen and fatty acid metabolism. Metabolism of Nitrogen containing compounds: nitrogen fixation, amino acids and nucleotides. Photosynthesis: the Calvin cycle.</p> <p>Biological membranes. Transport across membranes. Signal transduction; hormones and neurotransmitters. DNA replication, transcription and translation; Biochemical regulation of gene expression; Recombinant DNA technology and applications: PCR, site directed mutagenesis and DNA-microarray.</p>			
<b>Unit-III: <i>Immune system</i></b>			
<p>Active and passive immunity. Complement system. Antibody structure, function and diversity. Cells of the immune system: T, B and macrophages. T and B cell activation. Major histocompatibility complex. T cell receptor. Immunological techniques: Immunodiffusion, immunoelectrophoresis, RIA and ELISA.</p>			
<b>Reference Books:</b>			
<ol style="list-style-type: none"> <li>1. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Harper's Biochemistry, 25th ed. McGraw Hill health Professions Division, New York, USA, 1998.</li> <li>2. A.V.S.S. Rama Rao, Text Book of Biochemistry, 6th ed., L. K. &amp; S. Publishers, Visakhapatnam, 1991.</li> <li>3. Melson David L. Lehninger Principles of Biochemistry, 3rd ed. Macmillan worth Publishers, N. Y. USA, 2001.</li> <li>4. Stryer Lubert, Berg Jeremy M., Tymoczko Johan L, Biochemistry, 5th ed. W. H. Freeman &amp; Company New York, 2002</li> </ol>			

5. M. C. Pant, Essentials of Biochemistry, 8th ed., Kedar nath Ram Nath & Co. Publishers, Meerut, 1996.
6. E. David Metzler, Carol M. Metzler, David J. Sauke, Biochemistry the chemical reactions of living cells, 2nd ed., Har court/Academic Press, New York.

Course Title	Course Code	Credits	Marks
Spectroscopy	CHMPGCCT06	4	50
<b>Unit-I: Nuclear magnetic resonance spectroscopy (NMR)</b>			
<p>a) <math>^{13}\text{C}</math> NMR spectroscopy-principles, instrumentation, principles of decoupling, <math>^{13}\text{C}</math>-chemical shifts and structure of organic molecules. Interpretation of <math>^{13}\text{C}</math>-NMR spectra of organic compounds.</p> <p>b) Gated decoupling difference spectroscopy; Relaxation process, Population transfer, Selective polarization transfer.</p> <p>c) INEPT, basic two-dimensional sequence, Homonuclear shift correlation.</p> <p>d) Application of DEPT, 1H- 1H COSY, HMBC, HOHAHA (TOCSY).</p> <p>e) NOE in structure elucidation of organic compounds.</p>			
<b>Unit-II: Mass spectroscopy</b>			
<p>Theory, Instrumentation and Ionization methods (FAB, ESI, MALDI, FD etc.), Application of HRIEMS, MS-MS, GC-MS, LC-MS.</p> <p>Mass spectrometers (MALDI, TOF, ES) in structure elucidation of small and macromolecules.</p>			
<b>Unit-III: Mössbauer spectroscopy</b>			
<p>Basic Principles, Instrumentation, spectral parameters and spectral display. Centre shift, Quadrupole and magnetic interactions. Application to the to the elucidation of structure and bonding of Fe(III) and Fe(II) , Sn(IV), and Sn(II) compounds. Detection of oxidation states and in equivalent MB atoms.</p> <p><b>PES:</b> Photo excitation and photo ionization (XPS, ESCA) and valence level (UPS) experiments, detection of atoms in molecules, chemical shift, differentiating same element in different environment.</p>			
<b>Unit-IV: Electron Spin Resonance (ESR) spectroscopy</b>			
<p>Introduction, Principles, Instrumentation and application in detection of free radicals in chemical and biological systems.</p>			
<b>Reference Books:</b>			

1. Herald Gunther, NMR Spectroscopy: Basic Principles Concepts and Applications in Chemistry, John Wiley 2002.
2. Atta-ur- Rahman, One and Two Dimensional NMR Spectroscopy, Elsevier, 2010.
3. Mossbauer Spectroscopy and Transition Metal Chemistry (Fundamentals and Applications)-Philipp Guetlich, Eckhardt bill, A. X. Trautwein.
4. Electron Paramagnetic Resonance-Elementary Theory and Practical Applications-John A. Weil, James R. Bolton & John E. Wertz.
5. Mössbauer Spectroscopy by N. N. Greenwood and T. C. Gibb.

Course Title	Course Code	Credits	Marks
Medicinal Chemistry- I	CHMPGCCT07	4	50
<b>Unit-I</b>			
Basic concept of drug, drug receptor interaction, agonist and antagonist, isoster and bioisoster.			
<b>Unit-II</b>			
Beta lactam antibiotics: Penicillins, Cephalosprins including their semi-synthetic products. Monobactams.			
<b>Unit-III</b>			
Tetracyclines, Semi-synthetic tetracyclines, Gentamycins, Neomycins, Kanamycins, Fluoroquinoolines type of antibacterials.			
<b>Unit-IV</b>			
Antiprotozoal such as Antimalarials, Antiamoebics, Antihelminths.			
<b>Unit-V</b>			
Antifungal drugs includes Amphotericin-B, Nystatin, Natamycin, Griseofulvin, Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole.			
<b>Unit-VI</b>			
Inorganic pharmaceutical products			
<b>Major extra and intracellular electrolytes:</b> Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.			
<b>Gastrointestinal agents</b>			
<b>Acidifiers:</b> Ammonium chloride* and Dil. HCl			
<b>Antacid:</b> Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*,			

Aluminum hydroxide gel, Magnesium hydroxide mixture

**Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

**Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide\*, Chlorinated lime\*, Iodine and its preparations

**Radiopharmaceuticals:** Radio activity, Measurement of radioactivity, precautions & pharmaceutical application of radioactive substances.

**Reference Books:**

1. William O. Foye, Principles of Medicinal Chemistry, 3rd ed., Varghese Publishing House, Mumbai, 1989.
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9th ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's Medicinal Chemistry & Drug Discovery, 5th ed., Wiley Interscience, New York, 1995.
4. H. Singh and V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, 1st ed., Vallabh Prakashan, Delhi, 1996.
5. Ashutosh Kar, Medicinal Chemistry, New Age International (P) Limited, New Delhi, 1993.

Course Title	Course Code	Credits	Marks
Chemistry of Natural Products	CHMPGCCT08	4	50
<b>Unit-I: Terpenoids and Carotenoids</b>			
Classification, nomenclature, occurrence, isolation, isoprene rule and special isoprene rule general methods of structure determination. Structure determination, stereochemistry and synthesis of the following representative molecules: Citral, Geraniol, Terpeneol, Farnesol and Zingiberene.			
<b>Unit-II: Alkaloids</b>			
Definition, nomenclature and physiological action, occurrence, classification, isolation, general methods of structure elucidation, degradation. Structure determination, stereochemistry and synthesis of the following: Ephedrine, Nicotine, Atropine, Reserpine and Morphine.			
<b>Unit-III: Steroids</b>			
Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation,			

structure determination and synthesis of Cholesterol. Bile acids, Androsterone, Testosterone, Progesterone.

**Unit-IV: *Flavonoids and Isoflavonoids***

Occurrence, nomenclature, Isolation, structure determination and synthesis of Apigenine, Luteoline, Quercetin, Butein.

**Reference Books:**

1. Chemistry of Alkaloids-S. W. Pelletier
2. The Molecules of Nature-J. B. Hendrickson
3. Biogenesis of Natural Compound – Benfield
4. Natural Product Chemistry and Biological Significance- J. Mann, R. S. Devison, J. B. Hobbs, D. V. Banthripde and J. B. Horborne
5. Introduction to Flavonoids-B. A. Bohm, Harwood
6. Organic chemistry, Vol-I&II,- Finar
7. Organic Chemistry- Clayden, J, Greeves, N, Warren, S. and Wothers, P

Course Title	Course Code	Credits	Marks
Chemistry Practical-II	CHMPGCCP02	4	50
<b>Unit I: <i>Qualitative Analysis of liquid compound</i></b>			
a) Qualitative analysis of liquid compounds. Determination of boiling point.			
b) Preparation of derivatives			
<b>Unit II: <i>Quantitative Analysis</i></b>			
a) Estimation of acid value (analysis of an oil)			
b) Estimation of methoxy group by Zeisel's method			
<b>Unit III: <i>Biochemical lab</i></b>			
a) Qualitative detection of Carbohydrate, amino acid, protein and fats.			
b) Quantitative estimation of protein.			
<b>Reference Books:</b>			
1. Principles of Biochemistry by Lehninger.			
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.			
3. Biochemistry by Stryer.			
4. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)			
5. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.			
6. Practical Biochemistry by Harold Varley.			
7. Vogel's Textbook of Practical Organic Chemistry: A. I. Vogel, B. S. Furniss, P. W. Smith			
8. Practical Chemistry: Prof. S. Dutta.			
9. A Textbook On Chemistry Practical: Bidhan Chandra Ray, Satyanarayan Das			

## Semester-III

### A) Core Course

#### Medicinal Chemistry Specialization

Course Title	Course Code	Credits	Marks
Medicinal Chemistry -II	CHMPGCCT09	4	50
<b>To study the chemistry, structure, structure-activity relationship and therapeutic application of the following:</b>			
1. <b>Analgesic and Antipyretics:</b> Paracetamol, Salicylic acid analoges, Quinolones, Pyrazolones and Pyrazolodine, N-aryl Anthranilic acid and Hereroaryl Acetic Acid derivatives.			
2. <b>Local Anesthetics:</b> Benzoic acid derivatives, Cocaine derivatives			
3. <b>Central Nervous System Depressants and Stimulants:</b> General anesthetics, Inhalation anesthetics, Anxiolytic sedatives, Hypnotics, Anticonvulsants			
4. <b>Central Nervous System Stimulants:</b> Analeptics, Picrotoxins, Methylxanthines, Monoamine inhibitors, Tricyclic Compounds.			
5. <b>Anti-Neoplastic agents:</b> Alkylating agents, Antimetabolites, Antibiotics, Hormones, Methotrexate, Fluorouracil, Actinomycenes, Vincristine, Tamoxifen.			
6. <b>Cardiovascular agents:</b> Antianalgal agents, Vasodialators, Antiarrhythmic and Antihypertensive agents, Angiotensin-converting inhibitors, Antihyperlipidemic agents, Anticoagulants.			
7. <b>Antitubercular agents:</b> Ethambutol, iso-Nicotinic acid, Hydrazides, Thioguanine, Cytarbine, 5-Fluoracil, Dicarbazine, Streptomycine.			
8. <b>Sulphonamides</b> -such as Sulfamethoxazole, Sulfafurazole.			
9. <b>Antiviral agents</b> -Acyclovir, Ribavirin and current drugs			
<b>Reference Books:</b> 1) William O. Foye, Principles of Medicinal Chemistry, 3rd ed., Varghese Publishing House, Mumbai, 1989. 2) Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of			



Organic Medicinal and Pharmaceutical Chemistry, 9th ed. J.B. Lippincott Company, Philadelphia, 1991.

- 3) Manfred E. Wolff, Burger's Medicinal Chemistry & Drug Discovery, 5th ed., Wiley Interscience, New York, 1995.
- 4) H. Singh and V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, 1st ed., Vallabh Prakashan, Delhi, 1996.
- 5) Ashutosh Kar, Medicinal Chemistry, New Age International (P) Limited, New Delhi, 1993.
- 6) Uses of Inorganic Chemistry in Medicine by Nicholas P Farrell  
Textbook of Inorganic Pharmaceutical and Medicinal Chemistry by J. S. Qadry

Course Title	Course Code	Credits	Marks
Chemistry Practical-III	CHMPGCCP03	4	50
<b>Medicinal Chemistry Lab</b>			
<ol style="list-style-type: none"> <li>1. Assay of following drugs, Aspirin, Paracetamol, Metronidazole, Chloroquine, sulphanyl amide, amidoquin, Amoxicilin Amoxicilin, Phenobarbitone, Ibuprofen, (any four).</li> <li>2. Analysis of vitamin A, B6, B12, Folic Acid. (any two)</li> <li>3. Assay of antibiotics Bacitracin, Carbomycin, Chloramphenicol, Erythromycin, Penicillin (any three).</li> <li>4. Assay of natural antioxidant compounds and estimation of total phenol.</li> <li>5. Isolation, culture, staining and microscopic study of bacteria from water and soil.</li> <li>6. Study the antimicrobial activity of drugs against common bacteria.</li> </ol>			
<b>Reference Books:</b>			
<ol style="list-style-type: none"> <li>1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.</li> <li>2. Foye's Principles of Medicinal Chemistry.</li> <li>3. Burger's Medicinal Chemistry, Vol. I to IV.</li> <li>4. Remington's Pharmaceutical Sciences.</li> <li>5. Indian pharmacopeia 2007.</li> </ol>			

### Organic Chemistry Specialization

Course Title	Course Code	Credits	Marks
Heterocyclic Chemistry	CHMPGCCT10	4	50
<b>Unit-I</b>			
<p>Nomenclature: Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.</p> <p>Small ring heterocycles: Three-membered and four-membered heterocycles-synthesis and</p>			

reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes.

### Unit-II

Five membered heterocycles: Containing two heteroatoms (S,N,O). Diazoles, oxazoles and thiazoles.

Benzo-fused five-membered and six membered heterocycles: Synthesis and reactions of indoles, benzofurans and benzimidazoles, benzothiazoles.

Six-membered heterocycles with one heteroatom: Synthesis and reactions of pyrylium salts and pyrones, coumarins, chromones.

Six-membered heterocycles with 2 or more nitrogen atoms: Synthesis and reactions of diazines, triazines.

### Unit-III

Seven-membered heterocycles: Synthesis and reactions of azepines, oxepines, thiepinines, diazepines, benzodiazepines.

#### Reference Books:

1. Heterocyclic Chemistry- R K. Bansal
2. An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson
3. Chemistry of Heterocyclic Compounds- J. J. Trivedi
4. Heterocyclic Chemistry-Morton
- 5 The Chemistry of Heterocycles- T. Eicher and S. Hauptmann
6. Heterocyclic Chemistry-J. Joule and G. Smith
7. Principal of Modern Heterocyclic Chemistry-L. A. Paquette

Course Title	Course Code	Credits	Marks
Chemistry Practical-IV	CHMPGCCP04	4	50
<b>Preparation of Organic Compounds (minimum six)</b>			
(i) Benzoin from Benzaldehyde using thiamine as catalyst			
(ii) IBX from anthranilic acid			
(iii) Methyl Orange from sulphanilic acid			
(iv) Acetanilide from acetophenone <i>via</i> oxime			
(v) Phenytoin from benzil			
(vi) Paracetamol			
(vii) m-Nitro benzoic acid from benzaldehyde			
(viii) Synthesis of 3-Methylpyrazol-5-one			
(ix) Anthraquinone from phthalic anhydride			
(x) 2-Phenyl indole from phenyl hydrazine			

**B) Discipline Specific Elective Course Theory (DET) [any one (1) to be chosen out of two (2) options]**

Course Title	Course Code	Credits	Marks
Microbiology	CHMPGDET01	4	50
<b>Unit-I</b>			
<b>Historical Perspective:</b> Discovery of microbial world; Landmark discoveries relevant to the field of microbiology; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases.			
<b>Unit-II</b>			
<b>Methods in Microbiology:</b> Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Enrichment culture techniques for isolation of microorganisms; Light-, phase contrast- and electron-microscopy.			
<b>Unit-III</b>			
<b>Microbial Taxonomy and Diversity:</b> Bacteria, Archea and their broad classification; Eukaryotic microbes: Yeasts, molds and protozoa; Viruses and their classification; Molecular approaches to microbial taxonomy.			
<b>Unit-IV</b>			
<b>Prokaryotic and Eukaryotic Cells: Structure and Function:</b> Prokaryotic Cells: cell walls, cell membranes, mechanisms of solute transport across membranes, Flagella and Pili, Capsules, Cell inclusions like endospores and gas vesicles; Eukaryotic cell organelles: Endoplasmic reticulum, Golgi apparatus, mitochondria and chloroplasts.			
<b>Unit-V</b>			
<b>Microbial Growth:</b> Definition of growth; Growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; Effect of environmental factors on growth.			
<b>Unit-VI</b>			
<b>Control of Micro-organisms:</b> Effect of physical and chemical agents; Evaluation of effectiveness of antimicrobial agents.			
<b>Unit-VII</b>			
<b>Microbial Metabolism:</b> Energetics: redox reactions and electron carriers; An overview of metabolism; Glycolysis; Pentose-phosphate pathway; Entner-Doudoroff pathway; Glyoxalate pathway; The citric acid cycle; Fermentation; Aerobic and anaerobic respiration;			

Chemolithotrophy; Photosynthesis; Calvin cycle; Biosynthetic pathway for fatty acids synthesis; Common regulatory mechanisms in synthesis of amino acids; Regulation of major metabolic pathways.

### Unit-VIII

**Microbial Diseases and Host Pathogen Interaction:** Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; Emerging infectious diseases; Mechanism of microbial pathogenicity; Nonspecific defense of host; Antigens and antibodies; Humoral and cell mediated immunity; Vaccines; Immune deficiency; Human diseases caused by viruses, bacteria, and pathogenic fungi.

### Reference Books:

1. Microbiology Authors: Michael Pelczar, Jr.
2. Microbiology: An Introduction, 12th Edition Authors: Gerard J. Tortora, Berdell R. Funke and Christine L. Case
3. Brock Biology of Microorganisms, 14th Edition Authors: Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock
4. Prescott's Microbiology, 9th Edition Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton
5. Jawetz Melnick & Adelbergs Medical Microbiology, 26th Edition Authors: Geo. Brooks, Karen C. Carroll, Janet Butel and Stephen Morse
6. Greenwood Medical Microbiology, 18th Edition Authors: David Greenwood, Richard C. B. Slack, Michael R. Barer and Will L Irving

Course Title	Course Code	Credits	Marks
Advanced Stereochemistry	CHMPGDET02	4	50
<b>Unit-I Asymmetric synthesis</b>			
<p>Recapitulation of Stereochemical concepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, diastereo- and enantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Anh rule, chelate model, Houk model, <i>syn</i>- and <i>anti</i>-aldol, Zimmermann-Traxler TS.</p> <p>Principles of asymmetric synthesis: Use of chiral auxiliaries, chiral pool, Chiral reagent, Chiral catalyst. Asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation, asymmetric Diels-Alder reactions, Chiral borane reagents. Synthesis of</p>			

alpha amino acids (Corey's Diastereoselective hydrogenation of cyclic hydrazones); Synthesis of L-DOPA [Knowles's Mosanto process]. Use of Chiral BINOLs, BINAPs and chiral oxazolines and oxazolidones in asymmetric transformations.

**Unit-II Conformational analysis**

Conformational analysis of medium and large membered rings, transannular reactions, conformational analysis of cyclohexanone.

Stereochemistry of nitrogen containing compounds, strain and their consequences in small ring heterocycles, conformation of six membered heterocycles.

**Unit-III Optical rotatory dispersion and circular dichroism**

Phenomena of ORD and CD. Classification of ORD and CD Curves; Cotton effect and Cotton curves, deduction of absolute configuration.

Haloketo rule, the Octant rule and its application to alicyclic ketones.

**Reference Books:**

1. Organic Chemistry- Clayden, Greeves, Warren
2. Basic stereochemistry of organic molecules- Subrata Sengupta
3. Stereochemistry of organic compounds – Eliel
4. Stereochemistry of Organic Compounds : Principles and Applications- D. Nasipuri
5. Principles of Asymmetric Synthesis- Robert E. Gawley, Jeffrey Aube
6. A textbook of organic chemistry and problem analysis- K L Ghatak

**C) Discipline Specific Elective Course Practical (DEP)** [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Chemistry Practical-V	CHMPGDEP01	4	50
Unit-I Synthesis of medicinally active compounds			
<ol style="list-style-type: none"> <li>1. 7-Hydroxy-4-methyl coumarin</li> <li>2. 5, 5-Dimethyl-1, 3-Cyclohexanedione (or Dimedone)</li> <li>3. Benzocaine</li> <li>4. Coumarin-3-Carboxylic Acid</li> <li>5. Metamfepramone</li> <li>6. Chlorbutanol</li> <li>7. Hexamine</li> </ol>			
Unit-II Estimation of natural product			

1. Estimation of Caffeine from Tea
2. Estimation of Nicotine from Tobacco Leaves

**Reference Books:**

1. Advanced Practical Medicinal Chemistry, 1<sup>st</sup> Edition, Author: Ashutosh Kar.
2. Practical Medicinal Chemistry, Kindle Edition, Authors: Yogananda K., Jayaveera K.N., Subramanyam S. & Reddy
3. Natural Products Isolation, 2<sup>nd</sup> Edition, Authors: Satyajit D. Sarkar, Zahid Latif, Alexander I Gray

Course Title	Course Code	Credits	Marks
Chemistry Practical-VI	CHMPGDEP02	4	50
<b>Isolation of Organic Compounds from Natural Source (minimum six)</b>			
Isolation of:			
a) caffeine from tea leaves.			
b) casein from milk			
c) lactose from milk			
d) nicotine dipicrate from tobacco			
e) cinchonine from cinchona bark			
f) piperine from black pepper			
g) lycopene from tomatoes			
h) $\beta$ -carotene from carrots			
i) cysteine from hair			
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid)			
k) eugenol from cloves			
l) (+) limonine from citrus rinds			
m) Citric acid from lemon			
<b>Reference Books:</b>			
1. Vogel's Textbook of Practical Organic Chemistry: A. I. Vogel, B. S. Furniss, P. W. Smith			
2. Natural Products Isolation, 2 <sup>nd</sup> Edition, Authors: Satyajit D. Sarkar, Zahid Latif, Alexander I Gray			

**D) Generic Elective Course (GEC)** [any one (1) to be chosen out of two (2) options]

<b>Course Title</b>	<b>Course Code</b>	<b>Credits</b>	<b>Marks</b>
<b>Herbal Medicine</b>	CHMPGGEC01	<b>4</b>	<b>50</b>
<b>Unit-I</b>			
Introduction to Medicinally important Plant parts: Fruits, Leaves, Stem and its modifications (underground and aerial), Roots.			
<b>Unit-II</b>			
Plant identification – Elementary knowledge of Binomial nomenclature – Outline of Bentham and Hooker classification – Herbarium techniques.  Ethnomedicine – definition, history and its scope – Inter disciplinary approaches in ethnobotany – Collection of ethnic information.			
<b>Unit-III</b>			
Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).			
<b>Unit-IV</b>			
Classification of Crude drugs – Taxonomical, Morphological, Pharmacological and chemical classifications; Chemistry of drugs and its evaluation.			
<b>Unit-V</b>			
Analytical Pharmacognosy – drug adulteration and detection. Biological testing of herbal drug. Phytochemical investigations with reference to secondary metabolites of locally available medicinal plants.			
<b>Unit-VI</b>			
Drugs acting on brain and nervous system – Rheumatic arthritis – Psychoactive drugs – Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action.			
<b>Unit-VII</b>			
Cardiovascular diseases – blood pressure – cardiac drugs of plant origins – alkaloids, anticoagulants – basic mechanism of action. Pulmonary / respiratory disorders – asthma – bronchitis – common cold – allergy – Remedy from plants.			

**Unit-VIII**

Drugs for urinogenital disorders – roots of *Withania somnifera* – Memory stimulants – *Centella asiatica* – Drugs for dissolving kidney stones – *Musa paradisiaca* (pseudostem) – Antiinflammatory drugs – *Cardiospermum* – Anticancer drugs – *Catharanthus roseus*.

**Reference Books:**

1. Rosemary Gladstar's Medicinal Herbs: A Beginner's Guide, Authors: Rosemary Gladstar
2. Encyclopedia of Medicinal Plants, Authors: Andrew Chevallier
3. Pharmacognosy, Authors: C.K. Kokhate, A.P. Purohit, S.B. Gokhale.
4. Pharmacognosy, Authors: C. K. Kokhate, S. B. Gokhale. S.J. Surana, M.G. Kalaskar.
5. Kumar, N.C. (1993). An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi.
6. An Introduction to Medicinal Botany and Pharmacognosy – N.C. Kumar, Emkay Publications, Delhi.

Course Title	Course Code	Credits	Marks
Chemistry of Reagents	CHMPGGEC02	4	50
<b>Unit-I <i>Transition metals in organic synthesis</i></b>			
a) Introduction-oxidation states of transition metals, 16-18 rule, dissociation, association, insertion, oxidative addition, reductive elimination of transition metal.			
b) Organopalladium in organic synthesis-Heck reaction, allylic activation, carbonylation, wacker oxidation, isomerization, coupling reactions: Kumada Reaction, Stille coupling, Sonogashira and Suzuki coupling reactions and their importance.			
c) Applications of $\text{Co}_2(\text{CO})_8$ in organic synthesis. Wilkinson catalyst.			
d) Olefin metathesis by 1 <sup>st</sup> and 2 <sup>nd</sup> generation catalyst, reaction mechanism and application in the synthesis of homo and heterocyclic compounds			
<b>Unit-II <i>Redox Reactions</i></b>			
<b>1. Oxidation</b>			
a) Dehydrogenation by DDQ, chloranil and $\text{PhI}(\text{OAc})_2$ , Oxidation with $\text{SeO}_2$ .			
b) Oxidation of alcohols: pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collins and Jones reagent, Swern Oxidation, Oxidation with $\text{MnO}_2$ , Oppenauer oxidation			



- c) Oxidation of aldehydes and ketones, Chemistry and synthetic applications of  $\text{Pb}(\text{OAc})_4$ , Dess-Martin periodinane, IBX.

## 2. Reduction

- a) Catalytic heterogeneous and homogeneous hydrogenation, Adam catalyst, Wilkinson catalyst.
- b) Reduction of carbonyl compounds, conjugated systems.
- c) Reduction by hydride transfer reagents, Meerwein-Ponndorf-Verley reduction, Reduction with  $\text{LiAlH}_4$  and  $\text{NaBH}_4$ , Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride,  $\text{Bu}_3\text{SnH}$ , Reduction with diimide.

### Unit-III Chemistry of P, S, Si, B, and Ti compounds

- a) Phosphorus and sulphur ylides
- b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, thiamine hydrochloride based generation of acyl anion.
- c) Organoboranes- preparation and properties of organoborane reagents, uses in synthesis of alcohols, aldehydes, ketones, alkenes.
- d) Organosilicon compounds in organic synthesis,  $\text{Me}_3\text{SiCl}$ ,  $\text{Me}_3\text{SiH}$  and Peterson synthesis.
- e) Synthetic methodologies based on titanium compounds

### Reference Books:

1. Palladium Reagents and Catalysts, New Perspectives for the 21st Century- J. Tsuji (2003)
2. Organic Chemistry, Oxford University Press., J. Clayden, N. Greeves, S. Warren and P. Wothers
3. Principles and applications of organotransition metal chemistry- J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke.
4. Organometallic chemistry, Mehrotra R.C. and Singh A
5. The Chemistry of Organo Phosphorous-A. J. Kirby and S.G. Warren
6. Organo Silicon Compound-C. Eabon
7. Organic Synthesis via Boranes-H. C. Brown
8. Organic Chemistry of Boron-W. Gerrard
9. Modern Methods of Organic Synthesis-W. Carruthers

## Semester-IV

### A) Core Course

#### Medicinal Chemistry Specialization

Course Title	Course Code	Credits	Marks
Basic Pharmacology and Drug Delivery	CHMPGCCT11	4	50
<b>Unit-I</b>			
<b>General Pharmacology:</b> Introduction to pharmacology, Sources of Drugs, Dosage, Forms and routes of administration, Mechanism of action, Combined effect, Factors modifying Drug Action- Tolerance, dependence			
<b>Pharmacokinetics:</b> Absorption, Distribution, Metabolism, Excretion			
<b>Bioassay:</b> Definition, Merits and demerits of bioassay, Biological Standardization, Threshold dose, Bioassay of acetylcholine , Hydroxytryptamine, adrenaline, noradrenaline, sedative agents, oxitotin, digitals, different hormones, anesthetics, local anesthetics,			
<b>Unit-II</b>			
<b>Controlled drug delivery systems:</b> Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations			
<b>Microencapsulation:</b> Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications			
<b>Transdermal Drug Delivery Systems:</b> Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches			
<b>Gastroretentive drug delivery systems:</b> Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications			
<b>Nasopulmonary drug delivery system:</b> Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers			

**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications

**Reference Books:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
8. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
9. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

**Organic Chemistry Specialization**

Course Title	Course Code	Credits	Marks
Pharmaceutical Chemistry	CHMPGCCT12	4	50
<b>Unit-I Structure and activity</b>			
Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery.			
<b>Unit-II Antibiotics and antibacterials: Synthesis and Applications</b>			
(i) Introduction (ii) Antibiotic $\beta$ -Lactam type - Penicillins, Cephalosporins (iii) Antitubercular - Streptomycin (iv) Broad spectrum antibiotics - Tetracyclines (v) Anticancer - Dactinomycin (Actinomycin D) (vi) Antifungal – polyenes (vii) Antibacterial – Ciprofloxacin, Norfloxacin (viii) Antiviral – Acyclovir			
<b>Unit-III Antimalarials Drugs: Synthesis and Applications</b>			

Chemotherapy of malaria. Chloroquine, Chloroguanide and Mefloquine
<b>Unit-IV Non-steroidal Anti-inflammatory Drugs: Synthesis and Applications</b>
Diclofenac Sodium, Ibuprofen and Netopam
<b>Unit-V Antihistaminic and antiasthmatic agents: Synthesis and Applications</b>
Terfenadine, Cinnarizine, Salbutamol and Beclomethasone dipropionate.
<b>Reference Books:</b>
1. Text Book of Organic Medicinal Chemistry-Wilson, Geswold
2. Medicinal Chemistry Vol I and II-Burger
3. A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh
4. Introduction to Medicinal Chemistry-A. Gringuadge
5. An Introduction to Drug Design-S. S. Pandey and J. R. Demmock
6. Medicinal Chemistry-G. L.Patrick
7. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley
8. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press

**B) Discipline Specific Elective Course Theory (DET)** [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Industrial Pharmacy	CHMPGDET03	4	50
<b>UNIT-I</b>			
<b>Preformulation Studies:</b> Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.			
<i>a. Physical properties:</i> Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism			
<i>b. Chemical Properties:</i> Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant			
Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.			
<b>UNIT-II: Tablets</b>			
a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.			

b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.

c. Quality control tests: In process and finished product tests

### **UNIT-III: Capsules**

a. **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

c. **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

### **UNIT-IV: Parenteral Products**

a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity b. Production procedure, production facilities and controls, aseptic processing

c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.

d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

**Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

### **UNIT-V**

**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

**Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control

and stability studies.

**Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

**Reference Books:**

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B. Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman

Course Title	Course Code	Credits	Marks
<b>Applied Organic Chemistry</b>	<b>CHMPGDET04</b>	<b>4</b>	<b>50</b>
<b>Unit-I Polymer, Dyes and Pesticides</b>			
Basic Concepts of Polymers, mechanism of polymerization, characterization techniques for Polymers, applications of chain growth polymers (polyethylene, polyvinyles, polyamides etc.), synthetic rubbers, natural polymers. Synthesis of Azo dyes, reactive dyes, optical brighteners, thermal sensitive dyes. Classification of pesticides, chemical controls, Organo Phosphorus insecticides, fungicides, and rodenticides.			
<b>Unit-II Green Chemistry</b>			
Basic principles of Green Chemistry, Atom Economy, Selection of starting materials, Designing biodegradable products, Green reaction conditions, Green catalysis, Ionic liquids, Supercritical fluids, Fluorous phase reactions, Microwave and Ultrasound assisted reactions, Heterogeneous catalysis: Biocatalysis: Green analytical methods.			
<b>Unit-III Supramolecular Chemistry</b>			
Classification, thermodynamic and kinetic selectivity, Supramolecular interactions, host design, macrocyclic versus acyclic hosts, high dilution synthesis, template synthesis, Cation binding, cryptaspherands, heterocrowns, hetero-cryptands, selectivity of cation complexation, anion binding hosts, concepts in anion host design, cation hosts to anion hosts, pH effect. Self assembly-basic concepts, template effect on self assembly, self assembly of coordination complexes. Solid state supramolecular chemistry, supramolecular photochemistry.			

**Reference Books:**

1. Principles of Polymer Chemistry- A. Ravve
2. Polymer Chemistry- V.R Gowarikar, Vishwanathan Srikanth
3. Chemistry of Dyes (1-5 volumes)- R. Venkatraman
4. Synthetic Organic Chemistry- G.R. Chatwal and Gurudeep
5. Handbook of Industrial Chemistry: Organic Chemicals- Mohammad Farhat Ali, Bassam M. El Ali, James G. Speight
6. V. K. Ahluwalia, M. Kidwai, New trends in Green Chemistry, New Age Publications, 2004.
7. P.T. Anastas and J.C. Warner, Green Chemistry, Theory and Practice, Oxford University Press, 2000.
8. Jonathan W. Steed, David R. Turner, Karl J. Wallace, Core Concepts in Supramolecular Chemistry and Nanochemistry, John Wiley & Sons, 2007.
9. Jonathan W. Steed, Jerry. L. Atwood, Supramolecular Chemistry, John Wiley & Sons, 2002.

**C) Discipline Specific Elective Course Practical (DEP)** [any one (1) to be chosen out of two (2) options]

Course Title	Course Code	Credits	Marks
Chemistry Practical-VII	CHMPGDEP03	4	50
<ol style="list-style-type: none"><li>1. Synthesis of 1,4-bis(4-pyridyl)-2,3-diaza-1,3-butadiene (bpd)</li><li>2. Preparation of a Schiff base helicate component N,N'-(4,4'-Methylenebiphenyl)bis(salicylideneimine)</li><li>3. Preparation of crown ethers [18]Crown-6</li><li>4. Preparation of azacrown ethers</li><li>5. Preparation of copper phthalocyanine</li></ol>			
<b>Reference Books:</b>			
1. A practical guide to supramolecular chemistry by Peter Cragg, Wiley: Chichester, 2005.			

Course Title	Course Code	Credits	Marks
Chemistry Practical-VIII	CHMPGDEP04	4	50
<b>Unit-I</b>			
<b>Synthesis and characterization of metal complexes</b>			
1. Potassium trisoxalato ferrate (III): synthesis, analysis and photochemistry.			
<b>Unit-II</b>			
2. Determination of R <sub>f</sub> values of amino acids and cations by paper chromatography.			
3. Purification of the compounds by crystallization, TLC and chromatographic techniques.			
4. Determination of the pH of a given solution through matching its colour developed by an indicator.			
5. Determination of COD of sewage water.			
<b>Reference Books:</b>			
1. Vogel's Textbook of Practical Organic Chemistry: A. I. Vogel, B. S. Furniss, P. W. Smith			
2. Practical Chemistry: Prof. S. Dutta.			
3. A Textbook On Chemistry Practical: Bidhan Chandra Ray, Satyanarayan Das			

**D) Generic Elective Course (GEC) [any one (1) to be chosen out of two (2) options]**

Course Title	Course Code	Credits	Marks
Pharmacokinetics and Pharmacodynamics	CHMPGGEC03	4	50
<b>Unit-I <i>Basic concept of pharmacokinetics and pharmacodynamics, Biopharmaceutics</i></b>			
(a) Passage of drugs across the biological barrier (Passive diffusion, active transport, facilitated diffusion, pinocytosis).			
(b) Factors affecting absorption, bioavailability and bioequivalents.			
<b>Unit-II <i>Pharmacokinetics</i></b>			
(a) Significance of plasma-drug concentration measurement.			
(b) Compartment model and compartment kinetics.			
(c) Pharmacokinetics of drug absorption.			
(d) Clearance concept			
(e) Excretion ratio.			



(f) Non linear pharmacokinetics.

**Unit-III Pharmacodynamics**

(a) Protein therapeutics

(b) Its pharmacodynamics binding, Interspecies scaling, Heterogeneity, Chemical modification, immunogenicity. Physiological pharmaceutical model – Mean residence time (MRT), Statistical moment theory (SMT), Mean absorption time (MAT) and mean dissolution time (MDT).

**Unit-IV Biotransformation**

Biotransformation of drugs, enzymes responsible for bio-transformations, microsomal and non-microsomal mechanisms Factors influencing enzyme induction and inhibition. Excretion of drugs, biliary and fecal excretion, Factors effecting drug metabolism, Drug metabolism in fetus and new born; Models to study drug metabolism, Dose effect relationships. Adverse drug reactions and drug interactions, toxic Reaction, allergic reaction, idiosyncrasy, acute poisoning and its treatment.

**Reference Books:**

- 1) Therapeutic Targets: Modulation, Inhibition, and Activation by Luis M. Botana, Mabel Loza
- 2) Flavonoid Pharmacokinetics: Methods of Analysis, Preclinical and Clinical Pharmacokinetics, Safety, and Toxicology by Neal M. Davies (Editor), Jaime A. Yanez (Editor), Basil Roufogalis
- 3) Clinical Pharmacokinetics and Pharmacodynamics: Concepts and Applications by Malcolm Rowland (Author), Thomas N. Toze
- 4) Essentials of Pharmacokinetics and Pharmacodynamics Second Edition by Thomas N. Tozer PharmD PhD (Author), Malcolm Rowland (Author)
- 5) Pharmacokinetic-Pharmacodynamic Modeling and Simulation by Peter L. Bonate PhD, FCP
- 6) Biopharmaceutics and Pharmacokinetics Paperback by Kulkarni
- 7) Biopharmaceutics & Pharmacokinetics Paperback by Madan

Course Title	Course Code	Credits	Marks
Bioorganic Chemistry	CHMPGGEC04	4	50
<b>Unit-I Nucleic Acids and Proteins</b>			
Nucleic acids: DNA replication, transcription and translation, Function of mRNA, tRNA, rRNA; DNA sequence determination by chemical and enzymatic methods, Genetic code, and carcinogenesis, laboratory synthesis of dinucleotides.			

Primary, secondary, tertiary, and quaternary structure of proteins.
<b>Unit-II Metabolism and Energetics</b>
Glycolysis, oxidative decarboxylation, citric acid cycle and oxidative phosphorylation.
<b>Unit-III Naturally occurring molecules</b>
<p>Porphyrin: Structure and synthesis of Haemoglobin and Chlorophyll</p> <p>Vitamin: Structure determination and synthesis of Thiamine (B1), Pyridoxine (B6) and Biotin (H)</p> <p>Prostaglandin: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE<sub>2</sub> and PGF<sub>2α</sub></p> <p>Enzymes: Introduction to biological catalysis, nomenclature, classification and specificity. Kind of reaction catalysed by enzymes.</p> <p>Chemistry of Co-enzymes.</p> <p>Fatty acid: Biological importance of fatty acids and lipids, even chain and odd chain fatty acids, saturated and unsaturated fats, ketone bodies.</p>
<b>Reference Books:</b>
<ol style="list-style-type: none"> <li>1. Albert L. Lehninger, David L. Nelson, Michael M. Cox., Principles of Biochemistry, CBS Publishers and Distributors, 1993.</li> <li>2. Lubert Stryer, Biochemistry, W. H. Freeman and Company, 4th edition, 1995.</li> <li>3. Christopher K. Mathews and K. E. Von Holder, Biochemistry, Benjamin/Cummings, 1990.</li> <li>4. Eric E. Conn, Paul K. Stumpf, George Brening and Roy H. Doi, Outlines of Biochemistry, 5<sup>th</sup> edition, John Wiley and Sons, 1987.</li> <li>5. F. A. Carey and R. J. Sundberg, (Eds) 3rd Edition, Part B. Plenum/Rosetta, 1990.</li> <li>6. I. Fleming, Selected Organic Synthesis, John Wiley and sons, 1982.</li> <li>7. Atta-ur-Rehman, Studies in Natural Products Chemistry, Vol.1 and 2, Elsevier, 1988.</li> </ol>

#### D) Project and Dissertation (PRJ)

Course Title	Course Code	Credits	Marks
Project and Dissertation	CHMPGPRJ01	4	50

**ALIAH UNIVERSITY**  
**DRAFT COURSE STRUCTURE FOR PG CBCS**  
**(Science, Humanities and Social Science)**

**1. Introduction:**

- These regulations shall be for the Two-year Postgraduate Degree programme (Choice Based Credit System) of Aliah University
- These regulations shall come to effect from 2021-2022
- These regulations shall remain valid till further amendment by the concerned authorities

**2. Duration of the Programme:**

The 2-Year Master's Degree Programme (under CBCS) shall be for a minimum duration of 04 consecutive semesters of 06 months each, i.e. two (02) academic years and will start as notified by University authority

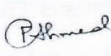
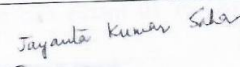
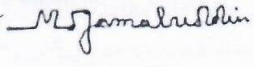

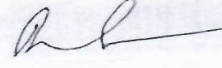
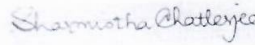


*A candidate shall have to clear all the semesters within four years from the academic year of his/her first admission to the University failing which enrolment of the candidate shall remain cancelled.*

**3. Programme Structure:**

The postgraduate Degree Programme namely 'Master of .....' of Aliah University consists of:

1. **Core Course (CCT and CCP): [Total Paper: 13; Total Credit: 13x4=56]**  
A discipline specific compulsory basic course. (Minimum 10 theory papers each of 4 credit i.e. totalling minimum 10x4 = 40 credit points is compulsory). For lab based disciplines, three practical papers (each of 4 credit) based on these 10 theory core course papers are mandatory, while for non-lab based disciplines, 13 theory papers each of 4 credit have to be considered.
2. **Discipline Specific Elective Course (DET and DEP): [Total Paper: 4 ; Total Credit: 4x4=16]**  
A discipline specific elective course (choice based) which is more advanced or specialized should be offered in the Semester- III and IV. 4 papers (3 theory and 1 practical) OR (2 theory and 2 practical) for lab based disciplines and 4 theory papers for non-lab based disciplines, each of 4 credit totalling 4x4 = 16 credit points have to be considered.
3. **Generic Elective Course (GEC): [Total Paper: 2 ; Total Credit: 2x4=8]**  
An inter-disciplinary elective course (choice based) to be opted from a discipline other than ones main discipline (s) of choice in the Semester-III and IV. (2 papers each of 4 credit totalling 2x4 = 8 credit points).
4. **Aliah University Compulsory Course (AUC): [Non-credit]** There will be Compulsory Course on "Elementary Arabic and Islamic Studies" having no credit points in Semester-I.
5. **Ability Enhancement Compulsory Course (AEC): [Non-credit]** There will be Compulsory Course on Disaster management/ Human Rights/ Value Education/ Yoga/ Soft Skills having no credit points in Semester-II.

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**6. Project and Dissertation (PRJ): [Total Paper: 1 ; Total Credit: 1x4=4]** Students have to work on a specific project and will write a dissertation on it followed by a presentation in Semester IV. (1 paper of 4 credit totalling 1x4 = 4 credit point).

- Each course carries 50 marks /4 credits. There will be a total of 20 credits each semester and a total of 80 credits in 2 years. There will be 13 compulsory core courses. In addition , a student has to mandatorily choose 4 DSE courses (2 in Semester III and 2 in Semester IV) out of 6 or 8 (DSE courses) and 2 GE course (1 in Semester III and 1 in Semester IV) out of 4 or 6 (GE courses). In Semester IV, in addition, a candidate has to write and defend a dissertation paper (PRJ) under the supervision of a teacher.

-The Non-credit course , (AUC) in Semester I is a compulsory one and has to be mandatorily studied by a student, whereas a student needs to choose 1 elective non-credit course (AEC) in Semester II out of 3 courses. Appearing in examinations for non-credit courses will be mandatory although the accrued credit may not be added to the total credits obtained by the student in other courses.

**Overall credit points and marks in the PG 4 semester**

Name of the course	Code	No of Paper x credit	No of Paper x full marks
Core Course	CCT/CCP	13 x 4 =52	13 x50 =650
Discipline Specific Elective Course	DET/DEP	4 x 4 =16	4 x50 =200
Generic Elective Course	GEC	2 x 4 = 8	2 x 50 =100
Project and Dissertation	PRJ	1 x 4 = 4	1 x 50 = 50
Aliah University Compulsory Course	AUC	0	0
Ability Enhancement Compulsory Course	AEC	0	0
		Total Credit = 80	Total marks = 1000

**COURSE CODING PATTERN**

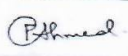
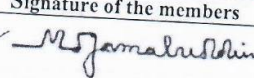



XYZPGABCpq, where, XYZ stands for departmental code (ENG, BEN, JMC, PHY, CHM, MAT), PG is the PG course, ABC stands for the category of courses (CCT, CCP, DET, DEP, GEC, PRJ etc), and pq stands for course number (01, 02, ..)- Each Course will have an alpha numeric code and the course structure will be as follows

Course description	Course code [SUBJECT-PG-COURSETYPE-NUMBER]
Core Course Theory (CCT)	ENGPCCCT00
Core Course Practical (CCP)	ENGPCCCP00
Department Specific Elective Course Theory (DET)	ENPGDET00
Department Specific Elective Course Practical (DEP)	ENPGDEP00
Generic Elective Course (GEC)	ENPGGEC00
Project and Dissertation (PRJ)	ENPGPRJ00
Aliah University Compulsory Course (AUC)	PGAUC00
Ability Enhancement Compulsory Course (AEC)	PGAEC00

**Question Pattern for Examinations:**

-Each Course will be evaluated through an Internal Assessment (IA) of 10 marks and a Semester End Examination of 40 marks.

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**Example: Syllabus structure for Department of English**

**Semester I**

Sl No.	Course Title	Course Code	Credits	Marks
1		ENGPCCCT01	4	50
2		ENGPCCCT02	4	50
3		ENGPCCCT03	4	50
4		ENGPCCCT04	4	50
5		ENGPCCCT05	4	50
6	Elementary Arabic and Islamic Studies	PGAUC01	Non-Credit	
			20	250

\* PGAUC01 - Aliah University Compulsory Course

**Semester II**

Sl No.	Course Title	Course Code	Credits	Marks
1		ENGPCCCT06	4	50
2		ENGPCCCT07	4	50
3		ENGPCCCT08	4	50
4		ENGPCCCT09	4	50
5		ENGPCCCT10	4	50
6	Disaster Management/ Human Rights & Value Education/Yoga & Life Skills (Any one of the above)	PGAEC01	Non-Credit	
			20	250

\* PGAEC01 - Ability Enhancement Compulsory Course

**Semester III**

Sl No.	Course Title	Course Code	Credits	Marks
1		ENGPCCCT11	4	50
2		ENGPCCCT12	4	50
3		ENGPGET01	4	50
4		ENGPGET02	4	50
5		ENPGGEC01	4	50
			20	250

\* ENGPGET01 - Discipline Specific Elective (Any 1 to be chosen out of 2 or 3 options)

ENPGGEC01 - GE-Generic Elective- (Any 1 to be chosen out of 2 or 3 options)

**SEMESTER IV**

Sl No.	Course Title	Course Code	Credits	Marks
1		ENGPCCCT13	4	50
2		ENGPGET03	4	50
3		ENGPGET04	4	50
4		ENPGGEC02	4	50
5	Project and Dissertation	ENGPGRJ01	4	50
			20	250

\* ENGPGET03 - Discipline Specific Elective (Any 1 to be chosen out of 2 or 3 options)

ENPGGEC02 - GE-Generic Elective- (Any 1 to be chosen out of 2 or 3 options)

ENGPGRJ01- Aliah University Internal Project and Dissertation

Signature of the members				

**Example: Syllabus structure for Department of Physics**

**Semester I**

Course Title	Course Code	Credits	Marks
	PHYPGCCT01	4	50
	PHYPGCCT02	4	50
	PHYPGCCT03	4	50
	PHYPGCCT04	4	50
Practical	PHYPGCCP01	4	50
Elementary Arabic and Islamic Studies	PGAUC01	Non-Credit	
		20	250

\* PGAUC01 - Aliah University Compulsory Course

**Semester II**

Course Title	Course Code	Credits	Marks
	PHYPGCCT05	4	50
	PHYPGCCT06	4	50
	PHYPGCCT07	4	50
	PHYPGCCT08	4	50
Practical	PHYPGCCP02	4	50
Disaster Management/ Human Rights & Value Education/Yoga & Life Skills (Any one of the above)	PGAEC01	Non-Credit	
		20	250

\* PGAEC01 - Ability Enhancement Compulsory Course

**Semester III**

Course Title	Course Code	Credits	Marks
	PHYPGCCT09	4	50
Practical	PHYPGCCP03	4	50
	PHYPGDET01	4	50
Practical	PHYPGDEP01	4	50
	PHYPGGEC01	4	50
		20	250

\* PHYPGDET01 - Discipline Specific Elective (Any 1 to be chosen out of 2 or 3 options)

PHYPGGEC01 - GE-Generic Elective- (Any 1 to be chosen out of 2 or 3 options)

**SEMESTER IV**

Course Title	Course Code	Credits	Marks
	PHYPGCCT10	4	50
	PHYPGDET02	4	50
Practical	PHYPGDEP02	4	50
	PHYPGGEC02	4	50
Project and Dissertation	PHYPGPRJ01	4	50
		20	250

\* PHYPGDET03 - Discipline Specific Elective (Any 1 to be chosen out of 2 or 3 options)

PHYPGGEC01 - GE-Generic Elective- (Any 1 to be chosen out of 2 or 3 options)

PHYPGPRJ01- Project and Dissertation

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