UNIVERSITY OF MUMBAI
No. UG/ 107 of 2015-16

CIRCULAR:-

A reference is invited to the Syllabi relating to the Bachelor of Vocation program in various faculties vide this Circular No UG/33 of 2014, dated 11th November, 2014 and the Principals of the affiliated Colleges in Arts, Science & Commerce and the Heads of recognized Institutions concerned are hereby informed that the recommendation made by the Faculty of Science at its meeting held on 11th August, 2015 has been accepted by the Academic Council at its meeting held 31st August, 2015 **vide** item No.4.8 and that in accordance therewith, the revised syllabus as per the Credit Based Semester and Grading System for the Bachelor of Vocation program in faculties of Arts/Commerce/Science in the course of Medical Laboratory Technology (Sem.I to VI), which are available on the University's web site (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2015-16.

MUMBAI – 400 032
15th October, 2015

REGISTRAR

To,

The Principals of the affiliated Colleges Arts, Science & Commerce and the Heads of Recognized Institutions concerned.

A.C/4.8/31/08/2015

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No. UG/ 107 -A of 2015 MUMBAI-400 032 15th October, 2015

Copy forwarded with Compliments for information to:-

1) The Deans, faculties of Arts, Science & Commerce,
2) The Professor-cum-Director, Institute of Distance & Open Learning (IDOL)
3) The Director, Board of College and University Development,
4) The Co-Ordinator, University Computerization Centre,
5) The Controller of Examinations.

19/10/15

REGISTRAR

AC 31/08/2015
Item No. 4.8

Vidya Vikas Education Society's
Vikas Night College of Arts, Science and Commerce
Kannamwar Nagar-2, Vikhroli (East), Mumbai 400083

Bachelor of Vocation (Medical Laboratory Technology)

B.Voc. (MLT) Syllabus
Year 1 (Diploma)
Semester I

Course Code	Component	Unit	Topic	Credits	L / Week
BMLT101 (General & Human Anatomy , Physiology –I)	Skill	I	Basics of Human Anatomy-I	04	01
	Skill	II	Basics of Physiology-I		01
	Skill	III	Basic English		01
	Skill	IV	Human Values and Professional Ethics		01
BMLT102 (Routine Laboratory Techniques-I)	Skill	I	Human Healthcare and Safety Regulations	04	01
	Skill	II	Introduction to Haematology and Routine tests		01
	Skill	III	Specimen Collection		01
	Skill	IV	Laboratory Preparation in Hematology		01
BMLT103 (Special Laboratory Techniques-I)	Skill	I	Biochemical Test Profile -I	04	01
	Skill	II	Biochemical Test Profile – II		01
	Skill	III	Elementary Knowledge of Chemistry- I		01
	Skill	IV	Elementary Knowledge of Chemistry- II		01
BMLT104 (Cell Biology and Biodiversity–I)	General	I	Microscopy and Organization of Cell -I	03	01
	General	II	Microscopy and Organization of Cell -II		01
	General	III	Systematic study of Animals - I		01
	General	IV	Systematic study of Animals - II		01
BMLT105 (Biomolecules)	General	I	Structure, Functions and Classification of Amino Acids and Proteins	03	01
	General	II	Structure, Functions and Classification of Carbohydrates		01
	General	III	Structure, Functions and Classification of Lipids		01
	General	IV	Physical and Chemical Properties of Nucleic Acids		01
BMLT106 (Fundamentals of Microbiology)	General	I	Introductory Microbiology-1	03	01
	General	II	Morphology and Structure of Microorganisms		01
	General	III	Recombinant DNA Technology		01
	General	IV	Microbial Ecology and Biotic Interactions		01
BMLTP101			Practicals of Course BMLT101	02	06
BMLTP102			Practicals of Course BMLT102	02	06
BMLTP103			Practicals of Course BMLT103	02	06
BMLTP104			Practicals of Course BMLT104	01	06
BMLTP105			Practicals of Course BMLT105	01	06
BMLTP106			Practicals of Course BMLT106	01	06
Total Credits				30	

Vidya Vikas Education Society's
Vikas Night College of Arts, Science and Commerce
Kannamwar Nagar-2, Vikhroli (East), Mumbai 400083

Bachelor of Vocation (Medical Laboratory Technology)

B.Voc. (MLT) Syllabus
Year 1 (Diploma)

Semester II

Course Code	Component	Unit	Topic	Credits	L / Week
BMLT107 (General & Human Anatomy , Physiology – II)	Skill	I	Basics of Human Anatomy-II	04	01
	Skill	II	Basics of Physiology-II		01
	Skill	III	Basics of Computer Skills		01
	Skill	IV	Communication Skills		01
BMLT108 (Routine Laboratory Techniques-II)	Skill	I	Routinue Haematological Tests	04	01
	Skill	II	Urine Examination		01
	Skill	III	Stool Examination		01
	Skill	IV	Sputum and Semen Examination		01
BMLT109 (Special Laboratory Techniques-II)	Skill	I	Basic Microbiology	04	01
	Skill	II	Introduction to serology		01
	Skill	III	Serological Tests		01
	Skill	IV	Staining Techniques		01
BMLT110 (Ecology and Biodiversity-II)	General	I	Systematic study of Animals - III	03	01
	General	II	Systematic study of Animals - IV		01
	General	III	Ecosystem-I		01
	General	IV	Ecosystem-II		01
BMLT111 (Enzymology and Bioenergetics)	General	I	Enzymes	03	01
	General	II	Enzyme Purification and Chromatography Techniques		01
	General	III	Enzyme Kinetics		01
	General	IV	Bioenergetics		01
BMLT112 Microbial Physiology - Metabolism	General	I	Microbial Nutrition, Cultivation, Isolation and Preservation	03	01
	General	II	Enzyme Regulation		01
	General	III	Microbial Metabolism -I		01
	General	IV	Microbial Metabolism -II		01
BMLTP107			Practicals of Course BMLT107	02	06
BMLTP108			Practicals of Course BMLT108	02	06
BMLTP109			Practicals of Course BMLT109	02	06
BMLTP110			Practicals of Course BMLT110	01	06
BMLTP111			Practicals of Course BMLT111	01	06
BMLTP112			Practicals of Course BMLT112	01	06
Total Credits				30	
On Job Training					

Vidya Vikas Education Society's
Vikas Night College of Arts, Science and Commerce
Kannamwar Nagar-2, Vikhroli (East), Mumbai 400083

Bachelor of Vocation (Medical Laboratory Technology)

B.Voc. (MLT) Syllabus

Year 2 (Advanced Diploma)

Semester III

Course Code	Component	Unit	Topic	Credits	L / Week
BMLT201 (Hematology and Blood Banking-I)	Skill	I	Special Heamatological Tests	04	01
	Skill	II	Haemostasis & Bleeding Disorders		01
	Skill	III	Immunohaematology & Blood Transfusion		01
	Skill	IV	Routine Lab Procedures in Blood Bank		01
BMLT202 (Microbiology and Serology)	Skill	I	Laboratory Diagnosis of Mycotic and Emerging Infections	04	01
	Skill	II	Diagnostic Microbiology		01
	Skill	III	Serology		01
	Skill	IV	Bacteriology		01
BMLT203 (Clinical Pathology and Biochemistry)	Skill	I	Miscellaneous Body Fluids	04	01
	Skill	II	Biochemical Test Profile		01
	Skill	III	Analytical Techniques		01
	Skill	IV	Biochemical Processes		01
BMLT204 (Metabolism)	General	I	Carbohydrate Metabolism	04	01
	General	II	Lipid Metabolism		01
	General	III	Protein Metabolism		01
	General	IV	Nucleic Acids		01
BMLT205 (Pathogenic Microbiology)	General	I	Infectious Diseases	04	01
	General	II	Microbes of Medical Importance		01
	General	III	Mode of Microbial Infections		01
	General	IV	Antimicrobial Drugs		01
BMLTP201			Practicals of Course BMLT201	02	06
BMLTP202			Practicals of Course BMLT202	02	06
BMLTP203			Practicals of Course BMLT203	02	06
BMLTP204			Practicals of Course BMLT204	02	06
BMLTP205			Practicals of Course BMLT205	02	06
Total Credits				30	

Vidya Vikas Education Society's
Vikas Night College of Arts, Science and Commerce
Kannamwar Nagar-2, Vikhroli (East), Mumbai 400083

Bachelor of Vocation (Medical Laboratory Technology)

B.Voc. (MLT) Syllabus

Year 2 (Advanced Diploma)

Semester IV

Course Code	Component	Unit	Topic	Credits	L / Week
BMLT206 (Clinical Biochemistry and Microbiology-I)	Skill	I	Metabolic Disorders & Deficiency	04	01
	Skill	II	Clinical Endocrinology		01
	Skill	III	Body Fluid Specimen Processing		01
	Skill	IV	Blood Banking		01
BMLT207 (Histolohy-Cytology –I)	Skill	I	Introduction to Histology	04	01
	Skill	II	Tissue Processing		01
	Skill	III	Staining Procedures		01
	Skill	IV	Instrumentation in Histocytotechnology		01
BMLT208 (Parasitology and Blood Cell Disirders-I)	Skill	I	Medical Parasitology	04	01
	Skill	II	Common Intestinal worms		01
	Skill	III	Malarial parasites, Filarial parasites		01
	Skill	IV	Lab. diagnosis of Parasitic infections		01
BMLT209 (Biochemical Techniques)	General	I	Spectroscopic Techniques	04	01
	General	II	Electrophoretic Techniques		01
	General	III	Chromatographic Techniques		01
	General	IV	Radio Isotopic Techniques		01
BMLT210 (Immunology)	General	I	Introduction to Immunology	04	01
	General	II	Humoral Immunity		01
	General	III	Cell Mediated Immunity		01
	General	IV	Antigen-Antibody Interactions		01
BMLTP206			Practicals of Course BMLT206	02	06
BMLTP207			Practicals of Course BMLT207	02	06
BMLTP208			Practicals of Course BMLT208	02	06
BMLTP209			Practicals of Course BMLT209	02	06
BMLTP210			Practicals of Course BMLT210	02	06
Total Credits				30	
On Job Training					

Vidya Vikas Education Society's
Vikas Night College of Arts, Science and Commerce
Kannamwar Nagar-2, Vikhroli (East), Mumbai 400083

Bachelor of Vocation (Medical Laboratory Technology)

B.Voc. (MLT) Syllabus
Year 3 (B.Voc. Degree)

Semester V

Course Code	Component	Unit	Topic	Credits	L / Week
BMLT301 (Medical Genetics and Microbiology-II)	Skill	I	Genetics	04	01
	Skill	II	CLIA techniques		01
	Skill	III	Immunology and Virology		01
	Skill	IV	Toxicology		01
BMLT302 (Histology-Cytology –II)	Skill	I	Exfoliative Cytology-Specimen Preparation	04	01
	Skill	II	Exfoliative Cytology- Staining Techniques		01
	Skill	III	Exfoliative Cytology- Benign and Malignant Cells		01
	Skill	IV	Advanced Instrumentation		01
BMLT303 (Parasitology and Blood Cell Disorders-II)	Skill	I	Descriptive study of RBC abnormalities	04	01
	Skill	II	Disorders related to RBC		01
	Skill	III	Normal White Cell Count & Physiological variation		01
	Skill	IV	Disorders related to WBC		01
BMLT304 (Pathogenic Microbiology)	General	I	Pathogenic Microbes, Diagnosis, Prevention and Control	10	01
	General	II	Prevention and Control of Viral Diseases		01
	General	III	Human Mycotic Infections		01
	General	IV	Mechanisms and Control of Parasitic Infections		01
BMLTP301			Practicals of Course BMLT301	02	06
BMLTP302			Practicals of Course BMLT302	02	06
BMLTP303			Practicals of Course BMLT303	02	06
BMLTP304			Practicals of Course BMLT304	02	06
Total Credits				30	

Vidya Vikas Education Society's
Vikas Night College of Arts, Science and Commerce
Kannamwar Nagar-2, Vikhroli (East), Mumbai 400083

Bachelor of Vocation (Medical Laboratory Technology)

B.Voc. (MLT) Syllabus

Year 3 (B.Voc. Degree)

Semester VI

Course Code	Component	Unit	Topic	Credits	L / Week
BMLT305 (Clinical Laboratory Operations and Management)	**Skill**	**I**	**Clinical Laboratory Operations and Management**	**04**	**04**
BMLT306 (Professional Training)	**Skill**	**I**	**Professional Training for three (3) months at reputed hospital, diagnostic centre, pathology laboratory, research institute, pharmaceutical industry, etc.**	**04**	**---**
BMLT307 (Project Work)	**Skill**	**I**	**Student shall carry out the project work in consultation with faculty and industrial partner organizations.**	**04**	**---**
BMLT308 (Food and Industrial Microbiology)	**General**	**I**	**Food Microbiology**	**10**	**01**
	General	**II**	**Contamination, Preservation and Spoilage of Food**		**01**
	General	**III**	**Production Strains Isolation and Screening Techniques**		**01**
	General	**IV**	**Fermentation Products**		**01**
BMLTP305			**Practicals of Course BMLT305**	**02**	**06**
BMLTP306			**Practicals of Course BMLT306**	**02**	**06**
BMLTP307			**Practicals of Course BMLT307**	**02**	**06**
BMLTP308			**Practicals of Course BMLT308**	**02**	**06**
Total Credits				**30**	

UNIVERSITY OF MUMBAI
No. UG/ 105 of 2015-16

CIRCULAR:-

A reference is invited to the Syllabi relating to the Bachelor of Vocation program in various faculties vide this Circular No UG/33 of 2014, dated 11th November, 2014 and the Principals of the affiliated Colleges in Arts, Science & Commerce and the Heads of recognized Institutions concerned are hereby informed that the recommendation made by the Faculty of Arts at its meeting held on 20th February, 2015 has been accepted by the Academic Council at its meeting held 31st August, 2015 **vide** item No.4.24 and that in accordance therewith, the revised syllabus as per the Credit Based Semester and Grading System for the Bachelor of Vocation program in faculties of Arts/Commerce/Science in the course of Media Production (Sem.I to VI), which are available on the University's web site (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2015-16.

REGISTRAR

MUMBAI – 400 032
15th October, 2015

To,

The Principals of the affiliated Colleges Arts, Science & Commerce and the Heads of Recognized Institutions concerned.

A.C/4.24/31/08/2015

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No. UG/ 105 -A of 2015 MUMBAI-400 032 15th October, 2015

Copy forwarded with Compliments for information to:-

1) The Deans, faculties of Arts, Science & Commerce,
2) The Professor-cum-Director, Institute of Distance & Open Learning (IDOL)
3) The Director, Board of College and University Development,
4) The Co-Ordinator, University Computerization Centre,
5) The Controller of Examinations.

15/10/15

REGISTRAR

...PTO

AC 31/08/2015

Item No. 4.24

Vidya Vikas Education Society's

Vikas Night College of Arts, Science & Commerce

Bachelor of Vocation (Media Production)

SUMMARY OF COURSE CONTENTS (SYLLABUS)

Year – I	
SEMESTER I	**SEMESTER II**
General Education 1.1 Importance of Effective Communication 1.2 History of Cinema & Film Appreciation 1.3 Introduction to History of Art **Skill Components** 1.4 Origination to Creative Writing & Literature (S.C.) 1.5 Basics of Photography (S.C.) 1.6 Practical - I & Internship Practical based on Art, Photography and cinema. (S.C.)	**General Education** 2.1 Structuring of Visual Media 2.2 New Media 2.3 Introduction to Television **Skill Components** 2.4 Story Boarding Ideas (S.C.) 2.5 Basics of Cinematography (S.C.) 2.6 Basics of Practical Film Making-II & Internship Practical based on Cinematography and visual media. (S.C.)

S.C. =Skill Component

Year – II	
SEMESTER III	**SEMESTER IV**
General Education 3.1 Current Affairs of World Cinema 3.2 Media Theory 3.3 Significance of Cinematography in Films **Skill Components** 3.4 Trends & technology in Films & Television (S.C.) 3.5 Direction for Films (S.C.) 3.6 Practical – III & Internship Practical based on film direction, cinematography. (S.C.)	**General Education** 4.1 Media Laws 4.2 Concepts of Advertisement Film Making 4.3 Understanding Concept of Direction for Television **Skill Components** 4.4 Visual Special Effects & Compositing (S.C.) 4.5 Post Production & Computer Graphics – I (S.C.) 4.6 Practical Film Making IV & Internship. Practical based on VFX, television study. (S.C.)

S.C. =Skill Component

Year –III	
SEMESTER V	**SEMESTER VI**
General Education 5.1 Media Project Management 5.2 Marketing & Publicity Design 5.4 Media Business **Skill Components** 5.3 Post Production & Computer Graphics – II (S.C.) 5.5 Sound & Sound Special Effects (S.C.) 5.6 Advance Practical Film Making Practical based on Sound special effects, Computer Graphics. (S.C.)	6.1 Final Project (Portfolio & Thesis) **All Skill components are included.**

S.C. =Skill Component

UNIVERSITY OF MUMBAI

No. UG/85 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges, the Head University Departments and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular Nos. UG/226 of 2006, dated 29th June, 2006 relating to syllabus of the Master of Science (M.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Chemistry at its meeting held on 28th May, 2018 have been accepted by the Academic Council at its meeting held on 14th June, 2018 **vide** item No. 4.71 and that in accordance therewith, the revised syllabus as per the (CBCS) for the M.Sc. in Organic Chemistry (Sem – III & IV), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
19th June, 2018

To

The Principals of the affiliated Colleges, the Head University Departments & Directors of the recognized Institutions in Science & Technology Faculty.
(Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.71/14/06/2018

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No. UG/85 -A of 2018 MUMBAI-400 032 19th June, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Chemistry,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

AC – 14/06/2018

Item No. 4.71

UNIVERSITY OF MUMBAI

Program : M.Sc.

(Choice Based Credit System)

Course : M.Sc. Organic Chemistry

Part – I

Syllabus for Semester III & IV

(To be implemented from the Academic year 2018-2019)

M.Sc. Organic Chemistry

Semester – III
Course Code: PSCHO301
Paper - I (**Theoretical organic chemistry-I**)

Unit 1	**Organic reaction mechanisms**	**[15L]**
1.1	Organic reactive intermediates, methods of generation, structure, stability and important reactions involving carbocations, nitrenes, carbenes, arynes and ketenes**.**	**[5L]**
1.2	Neighbouring group participation**:** Mechanism and effects of anchimeric assistance, NGP by unshared/ lone pair electrons, π-electrons, aromatic rings, σ-bonds with special reference to norbornyl and **bicyclo[2.2.2]octyl cation** systems (formation of non-classical carbocation)	**[3L]**
1.3	Role of FMOs in organic reactivity**:** Reactions involving hard and soft electrophiles and nucleophiles, ambident nucleophiles, ambident electrophiles, the α effect.	**[2L]**
1.4	Pericyclic reactions: Classification of pericyclic reactions; thermal and photochemical reactions. Three approaches: Evidence for the concertedness of bond making and breaking Symmetry-Allowed and Symmetry-Forbidden Reactions – • The Woodward-Hoffmann Rules-Class by Class • The generalised Woodward-Hoffmann Rule Explanations for Woodward-Hoffmann Rules • The Aromatic Transition structures [Huckel and Mobius] • Frontier Orbitals • Correlation Diagrams, FMO and PMO approach Molecular orbital symmetry, Frontier orbital of ethylene, 1,3 butadiene, 1,3,5 hexatriene and allyl system.	**[5L]**

Unit 2	**Pericyclic reactions**	**[15L]**
2.1	Cycloaddition reactions: Supra and antra facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes. Diels-Alder reactions, 1, 3-Dipolar cycloaddition and cheletropic reactions, ene reaction, retro-Diels-Alder reaction, regioselectivity, periselectivity, torquoselectivity, site selectivity and effect of substituents in Diels-Alder reactions. **Other Cycloaddition Reactions- [**4+6] Cycloadditions, Ketene Cycloaddition, Allene Cycloadditions, Carbene Cycloaddition, Epoxidation and Related Cycloadditions. Other Pericyclic reactions: Sigmatropic Rearrangements, Electrocyclic Reactions, Alder 'Ene' Reactions.	**[7L]**
2.2	Electrocyclic reactions: Conrotatory and disrotatary motions, 4nπ and (4n+2)π electron and allyl systems.	**[3L]**
2.3	Sigmatropic rearrangements: H-shifts and C-shifts, supra and antarafacial migrations, retention and inversion of configurations. Cope (including oxy-Cope and aza-Cope) and Claisen rearrangements. Formation of Vitamin D from 7-dehydrocholesterol, synthesis of citral using pericyclic reaction, conversion of Endiandric acid E to Endiandric acid A.	**[5L]**

Unit 3:	**Stereochemistry-I**	**[15L]**
3.1	Classification of point groups based on symmetry elements with examples (nonmathematical treatment).	**[2L]**
3.2	Conformational analysis of medium rings: Eight **to** ten membered rings and their unusual properties**,** I-strain, transannular reactions.	**[3L]**
3.3	Stereochemistry of fused ring and bridged ring compounds: decalins, hydrindanes, **perhydroanthracenes**, steroids, and Bredt's rule.	**[5L]**
3.4	**Anancomeric systems,** Effect of conformation on reactivity of cyclohexane derivatives in the following reactions (including mechanism): electrophilic addition, elimination, molecular rearrangements, reduction of cyclohexanones **(with $LiAlH_4$, selectride and MPV reduction)** and oxidation of cyclohexanols**.**	**[5L]**
Unit 4	**Photochemistry**	**[15L]**
4.1	Principles of photochemistry: quantum yield, electronic states and transitions, selection rules, modes of dissipation of energy (Jablonski diagram), electronic energy transfer: photosensitization and quenching process.	**[3L]**
4.2	Photochemistry of carbonyl compounds:$\pi \rightarrow \acute{\pi}^*$, $n \rightarrow \acute{\pi}^*$ transitions, Norrish- I and Norrish-II cleavages, Paterno-Buchi reaction. Photoreduction, calculation of quantum yield, photochemistry of enones, photochemical rearrangements of α, β-unsaturated ketones and cyclohexadienones. Photo Fries rearrangement, Barton reaction.	**[8L]**
4.3	Photochemistry of olefins: cis-trans isomerizations, dimerizations, hydrogen abstraction, addition and Di- π- methane rearrangement including aza-di- π -methane. Photochemical Cross-Coupling of Alkenes, Photodimerisation of alkenes.	**[2L]**
4.4	Photochemistry of arenes**:** 1, 2- , 1, 3- and 1, 4- additions. Photocycloadditions of aromatic Rings.	**[1L]**
4.5	Singlet oxygen and photo-oxygenation reactions. Photochemically induced Radical Reactions. Chemiluminescence.	**[1L]**

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2. A guide to mechanism in Organic Chemistry, 6th edition, 2009, Peter Sykes, Pearson education, New Delhi.
3. Advanced Organic Chemistry: Reaction Mechanisms, R. Bruckner, Academic Press (2002).
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5. Organic Reaction Mechanism, 4th edition, V. K. Ahluvalia, R. K. Parashar, Narosa Publication.
6. Reaction Mechanism in Organic Chemistry, S.M. Mukherji, S.P. Singh, Macmillan Publishers, India.
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Carey and Richard J. Sundberg, Springer.
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9 Organic reactive intermediates, Samuel P. MacManus, Academic Press.
10 Organic Chemistry, J. Clayden, S. Warren, N. Greeves, P. Wothers, 1st Edition, Oxford University Press (2001).
11 Organic Chemistry, Seventh Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.Advanced Organic Chemistry: Reactions & Mechanisms, second edition, B. Miller and R. Prasad, Pearson.
12 Organic reactions & their mechanisms, third revised edition, P.S. Kalsi, New Age International Publishers.
13 Organic Chemistry: Structure and Function, P. Volhardt and N. Schore, 5th Edition, 2012
14 Organic Chemistry, W. G. Solomons, C. B. Fryhle, , 9th Edition, Wiley India Pvt. Ltd.,2009.
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26 Organic Stereochemistry, M. J. T. Robinson, Oxford University Press, New Delhi, India edition, 2005
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31 Fundamentals of Photochemistry, K. K. Rohtagi-Mukherji, Wiley-Eastern
32 Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Sciertific Publication.

33 Molecular Photochemistry, N. J. Turro, W. A. Benjamin.
34 Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill
35 Photochemistry, R. P. Kundall and A. Gilbert, Thomson Nelson.
36 Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
37 Molecular Orbitals and Organic Chemical Reactions by Ian Fleming (Wiley – A john Wiley and Sons, Ltd., Publication)

Course Code: PSCHO302
Paper-II
Synthetic Organic Chemistry-I

Unit 1: Name reactions with mechanism and application [15L]

1.1 Mukaiyama esterification, Mitsonobu reaction, Darzen's Glycidic Ester syntheis, Ritter reaction, Yamaguchi esterification, Peterson olefination. **[5L]**

1.2 **Domino reactions**: Characteristics; Nazerov cyclization **[3L]**

1.3 **Multicomponent reactions**: Strecker Synthesis, Ugi 4CC, Biginelli synthesis, Hantzsch synthesis, Pictet-Spengler synthesis **[5L]**

1.4 **Click Reactions**: Characteristics; Huisgen 1,3-Dipolar Cycloaddition **[2L]**

Unit 2: Radicals in organic synthesis [15L]

2.1 **Introduction:** Generation, stability, reactivity and structural and stereochemical properties of free radicals, Persistent and charged radicals, Electrophilic and nucleophilic radicals. [3L]

2.2 **Radical Initiators**: azobisisobutyronitrile (AIBN) and dibenzoyl peroxide. [1L]

2.3 **Characteristic reactions** - Free radical substitution, addition to multiple bonds. Radical chain reactions, Radical halogenation of hydrocarbons (Regioselectivity),radical cyclizations, autoxidations: synthesis of cumene hydroperoxide from cumene. [4L]

2.4 **Radicals in synthesis**: Inter and intra molecular C-C bond formation via mercuric hydride, tin hydride, thiol donors. Cleavage of C-X, C-Sn, C-Co, C-S, O-O bonds. Oxidative coupling, C-C bond formation in aromatics: $S_{RN}Ar$ reactions. [4L]

2.5 Hunsdiecker reaction, Pinacol coupling, McMurry coupling, Sandmeyer reaction, Acyloin condensation. [3L]

Unit 3: Enamines, Ylides and α-C-H functionalization [15]

3.1 **Enamines:** Generation & application in organic synthesis with mechanistic pathways, Stork enamine reaction. Reactivity, comparison between enamines and enolates. Synthetic reactions of enamines including asymmetric reactions of chiral enamines derived from chiral secondary amines. [4L]

3.2 **Phosphorus, Sulfur and Nitrogen Ylides:** Preparation and their synthetic applications along with their stereochemical aspects. Wittig reaction, Horner-Wadsworth-Emmons Reaction, Barton-Kellogg olefination. [6L]

3.3 **α-C-H functionalization:** By nitro, sulfoxide, sulfone and phosphonate groups: generation of carbanions by strong bases (LDA/n-butyl lithium) and applications in C-C bond formation. Bamford-Stevens reaction, Julia olefination and its modification, Seyferth–Gilbert homologation, Steven's rearrangement. [5L]

Unit 4: Metals / Non-metals in organic synthesis [15]

4.1 **Mercury in organic synthesis:** Mechanism and regiochemistry of oxymercuration and demercuration of alkenes, mercuration of aromatics, transformation of aryl mercurials to aryl halides. Organomercurials as carbene transfer reagents. [3L]

4.2 **Organoboron compounds:** Mechanism and regiochemistry of hydroboration of alkenes and alkynes, asymmetric hydroboration using chiral boron reagents, 9-BBN hydroboration, oxazaborolidine (CBS catalyst) and functional group reduction by diborane. [3L]

4.3 **Organosilicons:** Salient features of silicon governing the reactivity of organosilicons, preparation and important bond-forming reactions of alkyl silanes, alkenyl silanes, aryl silanes and allyl silanes. β-silyl cations as intermediates. Iodotrimethylsilane in organic synthesis. [3L]

4.4 **Silyl enol ethers**: Application: As nucleophiles (Michael reaction, Mukaiyama aldol reaction), in ring contraction reactions. [2L]

4.5 **Organotin compounds**: Preparation of alkenyl and allyl tin compounds; application in C-C bond formation, in replacement of halogen by H at the same C atom. [2L]

4.6 **Selenium in organic synthesis:** Preparation of selenols/selenoxide, selenoxide elimination to create unsaturation, selenoxide and seleno acetals as α-C-H activating groups [2L]

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- **Organic Electrochemistry,** H. Lund, and M. Baizer, 3rd Edn., Marcel Dekker.

Course Code: PSCHO303
Paper-III
Natural products and Spectroscopy

Unit 1: Natural products-I **[15L]**

1.1 **Carbohydrates:** Introduction to naturally occurring sugars: Deoxysugars, aminosugars, branched sugars. Structure elucidation of lactose and D-glucosamine (synthesis not expected).Structural features and applications of inositol, starch, cellulose, chitin and heparin**.** [5L]

1.2 **Natural pigments:** General structural features, occurrence, biological importance and applications of: carotenoids, anthocyanins, quinones, flavones, pterins and porphyrins (chlorophyll). Structure elucidation of β-carotene and Cyanin (with synthesis). Synthesis of ubiquinone from 3, 4, 5-trimethoxyacetophenone. [5L]

1.3 **Insect pheromones:** General structural features and importance. Types of pheromones (aggregation, alarm, releaser, primer, territorial, trail, sex pheromones etc.), advantage of pheromones over conventional pesticides. Synthesis of bombykol from acetylene, disparlure from 6-methylhept-1-ene, grandisol from 2-methyl-1, 3-butadiene**.** [3L]

1.4 **Alkaloids:** Occurrence and physiological importance of morphine and atropine. Structure elucidation, spectral data and synthesis of coniine. [2L]

Unit 2: Natural products-II **[15L]**

2.1 **Multi-step synthesis of natural products:** Synthesis of the following natural products with special reference to reagents used, stereochemistry and functional group transformations: [8L]

a) Woodward synthesis of Reserpine from benzoquinone
b) Corey synthesis of Longifoline from resorcinol
c) Gilbert-Stork synthesis of Griseofulvin from phloroglucinol
d) Corey's Synthesis of Caryophyllene from 2-Cyclohexenone and Isobutylene
e) Synthesis of Juvabione from Limonene

f) Synthesis of Taxol.

2.2 **Prostaglandins:** Classification, general structure and biological importance. Structure elucidation of **PGE_1**. [2L]

2.3 **Lipids:** Classification, role of lipids, Fatty acids and glycerol derived from oils and fats. [2L]

2.4 **Insect growth regulators:** General idea, structures of JH_2 and JH_3 . [1L]

2.5 **Plant growth regulators:** Structural features and applications of arylacetic acids, gibberellic acids and triacontanol. Synthesis of triacontanol (synthesis of stearyl magnesium bromide and 12-bromo-1-tetrahydropyranyloxydodecane expected). [2L]

Unit 3: Advanced spectroscopic techniques-I **[15L]**

3.1 **Proton NMR spectroscopy:** Recapitulation, chemical and magnetic equivalence of protons, First order, second order, Spin system notations (A_2, AB, AX, AB_2, AX_2, AMX and A_2B_2-A_2X_2 spin systems with suitable examples). Long range coupling (Allylic coupling, 'W' coupling and Coupling in aromatic and heteroaromatic systems), Temperature effects, Simplification of complex spectra, nuclear magnetic double resonance, chemical shift reagents. [7L]

3.2 **^{13}C –NMR spectroscopy:** Recapitulation, equivalent and non-equivalent carbons (examples of aliphatic and aromatic compounds), ^{13}C- chemical shifts, calculation of ^{13}C- chemical shifts of aromatic carbons, heteronuclear coupling of carbon to ^{19}F and ^{31}P. [4L]

3.3 Spectral problems based on UV, IR, ^{1}HNMR and ^{13}CNMR and Mass spectroscopy . [4L]

Unit 4: Advanced spectroscopic techniques-II **[15L]**

4.1 **Advanced NMR techniques:** DEPT experiment, determining number of attached hydrogens (Methyl/methylene/methine and quaternary carbons), two dimensional spectroscopic techniques, COSY and HETCOR spectra, NOE and NOESY techniques. [10L]

4.2 Spectral problems based on UV, IR, ^{1}HNMR, ^{13}CNMR (Including 2D technique) and Mass spectroscopy [5L]

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Course Code: PSCHOEC-I 304
Paper-IV
Medicinal , Biogenesis and green chemistry

Unit 1:	**Drug discovery, design and development**	**[15L]**
1.1	Introduction, important terms used in medicinal chemistry: receptor, therapeutic index, bioavailability, drug assay and drug potency. General idea of factors affecting bioactivity: Resonance, inductive effect, bioisosterism, spatial considerations. Basic pharmacokinetics: drug absorption, distribution, metabolism (biotransformation) and elimination. Physical and chemical parameters like solubility, lipophilicity, ionization, pH, redox potential, H-bonding, partition coefficient and isomerism in drug distribution and drug-receptor binding.	[7]
1.2	Procedures in drug design: Drug discovery without a lead: Penicillin, Librium. Lead discovery: random screening, non-random (or targeted) screening. Lead modification: Identification of the pharmacophore, Functional group modification. Structure-activity relationship, Structure modification to increase potency and therapeutic index: Homologation, chain branching, ring-chain transformation, bioisosterism, combinatiorial synthesis (basic idea).	[8L]
Unit 2:	**Drug design, development and synthesis**	**[15L]**
2.1	Introduction to quantitative structure activity relationship studies. QSAR parameters: - steric effects: The Taft and other equations; Methods used to correlate regression parameters with biological activity: Hansch analysis- A linear multiple regression analysis.	[5L]
2.2	Introduction to modern methods of drug design and synthesis- computer-aided molecular graphics based drug design, drug design via enzyme inhibition (reversible and irreversible), bioinformatics and drug design.	[3L]
2.3	Concept of prodrugs and soft drugs. (a) Prodrugs: Prodrug design, types of prodrugs, functional groups in prodrugs, advantages of prodrug use. (b) Soft drugs: concept and properties.	[3L]
2.4	Synthesis and application of the following drugs: Fluoxetine, cetrizine, esomeprazole, fluconazole, zidovudine, methotrexate, diclofenac, labetalol, fenofibrate.	[4L]
Unit 3:	**Biogenesis and biosynthesis of natural products**	**[15L]**
3.1	Primary and secondary metabolites and the building blocks, general pathway of amino acid biosynthesis.	[3L]

3.2	Acetate pathway: Biosynthesis of malonylCoA, saturated fatty acids, prostaglandins from arachidonic acid, aromatic polyketides.	[4L]
3.3	Shikimic Acid pathway: Biosynthesis of shikimic acid, aromatic amino acids, cinnamic acid and its derivatives, lignin and lignans, benzoic acid and its derivatives, flavonoids and isofalvonoids.	[4L]
3.4	Mevalonate pathway: Biosynthesis of mevalonic acid, monoterpenes – geranyl cation and its derivatives, sesquiterpenes – farnesyl cation and its derivatives and diterpenes.	[4L]

Unit 4: Green chemistry **[15L]**

4.1	Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts.	[1L]
4.2	Use of the following in green synthesis with suitable examples: a) Green reagents: dimethylcarbonate, polymer supported reagents. b) Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts [Aliquat 336, benzyltrimethyl ammonium chloride (TMBA), Tetra-n-butyl ammonium chloride, crown ethers], biocatalysts. c) Green solvents: water, ionic liquids, deep eutectic solvents, supercritical carbon dioxide. d) Solid state reactions: solid phase synthesis, solid supported synthesis e) Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions. f) Ultrasound assisted reactions.	[9L]
4.3	Comparison of traditional processes versus green processes in the syntheses of ibuprofen, adipic acid, 4-aminodiphenylamine, p-bromotoluene and benzimidazole.	[3L]
4.4	Green Catayst : Nanocatalyst, Types of nanoctalysts, Advantages and Disadvantages of Nanocatalysts, Idea of Magnetically separable nanocatalysts.	[2L]

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Course Code: PSCHOEC-II 304
Paper-IV
Bioorganic chemistry

Unit 1:	**Biomolecules-I**	**[15L]**
1.1	Amino acids, peptides and proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures, α- helix, β-sheets, super secondary structure. Tertiary structure of protein: folding and domain structure. Quaternary structure.	[2L]
1.2	Nucleic acids: Structure and function of physiologically important nucleotides (c-AMP, ADP, ATP) and nucleic acids (DNA and RNA), replication, genetic code, protein biosynthesis, mutation.	[3L]
1.3	Structure: Purine & pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) formation of polynucleotides strand with its shorthand representation**.**	[3L]
1.4	RNAs (various types in prokaryotes and eukaryotes) m- RNA and r- RNA – general account , t- RNA-clover leaf model, Ribozymes**.**	[2L]
1.5	DNA: Physical properties – Effect of heat on physical properties of DNA (Viscosity, buoyant density and UV absorption), Hypochromism, Hyperchromism and Denaturation of DNA. Reactions of nucleic acids (with DPA and Orcinol).	[2L]
1.6	Chemical synthesis of oligonucleotides: Phosphodiester, Phosphotriester,	[3L]

Phosphoramidite and H- phosphonate methods including solid phase approach.

Unit 2: Biomolecules-II **[15L]**

2.1 Chemistry of enzymes: Introduction, nomenclature, classes and general types of reactions catalyzed by enzymes. Properties of enzymes: a) enzyme efficiency/ catalytic power b) enzyme specificity; Fischer's 'lock and key' and Koshland 'induced fit' hypothesis. Concept and identification of active site. [6L]

2.2 Factors affecting enzyme kinetics: Substrate concentration, enzyme concentration, temperature, pH, product concentration etc. Reversible and irreversible inhibition. [4L]

2.3 Mechanism of enzyme action: transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Mechanism of chymotrypsin catalyzed hydrolysis of a peptide bond. [5L]

Unit 3: Biomolecules - III **[15L]**

3.1 Chemistry of coenzymes. Structure, mechanism of action and bio-modeling studies of the following coenzymes: nicotinamide adenine dinucleotide, flavin adenine dinucleotide, thiamine pyrophosphate, pyridoxal phosphate, Vitamin B12, biotin, lipoic acid, Coenzyme A. [12L]

3.2 Oxidative phosphorylation, chemiosmosis, rotary model for ATP synthesis and role of cytochrome in oxygen activation. [3L]

Unit 4: Biomolecules – IV **[15L]**

4.1 Role of main enzymes involved in the synthesis and breakdown of glycogen. [2L]

4.2 Enzyme catalyzed organic reactions: Hydrolysis, hydroxylation, oxidation and reduction. [6L]

4.3 Enzymes in organic synthesis. Fermentation: Production of drugs/drug intermediates by fermentation. Production of chiral hydroxy acids, vitamins, amino acids, β-lactam antibiotics. Synthesis of chemicals via microbial transformation, synthesis of L-ephedrine. Chemical processes with isolated enzymes in free form (hydrocyanation of m-phenoxybenzaldehyde) and immobilized form (production of 6-aminopenicillanic acid). [7L]

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30. Bioorganic Chemistry- A practical approach to Enzyme action, H. Dugas and C. Penny. Springer Verlag, 1931
31. Biochemistry: The chemical reactions in living cells, by E. Metzler. Academic Press.
32. Concepts in biotechnology by D. Balasubrarnanian & others
33. Principals of biochemistry by Horton & others.

34. Bioorganic chemistry - A chemical approach to enzyme action by Herman Dugas and Christopher Penney.
35. Medicinal Natural Products: A Biosynthetic Approach by Paul M. Dewick. 3rd Edition, Wiley.
36. Natural product chemistry, A mechanistic, biosynthetic and ecological approach, Kurt B. G. Torssell, Apotekarsocieteten – Swedish pharmaceutical press.
37. Natural products Chemistry and applications, Sujata V Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House.
38. Natural Products Volume- 2, By O. P. Agarwal.
39. Chemistry of Natural Products, F. F. Bentley and F. R. Dollish, 1974.
40. Natural Product Chemistry Vol.1 and 2, K. Nakanishi J. Goto. S.Ito Majori and S. Nozoo, Academic Press, 1974.
41. Chemistry of natural products, V.K. Ahluwalia, Vishal Publishing Co.
42. Green Chemistry: An Introductory Text, 2nd Edition, Published by Royal Society of Chemistry, Authored by Mike Lancater.
43. Organic synthesis in water. By Paul A. Grieco, Blackie.
44. Green chemistry, Theory and Practical, Paul T. Anastas and John C. Warner.
45. New trends in green chemistry By V. K. Ahulwalia and M. Kidwai, 2nd edition, Anamaya Publishers, New Delhi.
46. An introduction to green chemistry, V. Kumar, Vishal Publishing Co.
47. Organic synthesis: Special techniques. V.K.Ahulwalia and Renu Aggarwal.

Semester III: Practicals

Course code: PSCHO3P1

Separation of a ternary mixture of organic compounds and identification including derivative preparations using micro-scale technique

1. Separation of a ternary mixture (S-S-S, S-S-L, S-L-L and L-L-L) (for solid mixture: water insoluble/ soluble including carbohydrates) based upon differences in the physical and the chemical properties of the components.
2. Identification of the two components (indicated by the examiner) using micro-scale technique.
3. Preparation of derivatives (any one of separated compound).

(**Minimum 8 experiments**)

Course code: PSCHO3P2

Single step organic preparation(1.0 g scale) involving purification by Steam distillation / Vacuum distillation or Column chromatography.

1. Preparation of acetanilide from aniline and acetic acid using Zn dust. (Purification by column chromatography)
2. Preparation of 1-nitronaphthalene from naphthalene. (Purification by steam distillation)
3. .Preparation of acetyl ferrocene from ferrocene. (Purification by column chromatography)

4. .Preparation of 3-nitroaniline from 1,3-dinitrobenzene. (Purification by column chromatography)
5. Preparation of benzyl alcohol from benzaldehyde. (Purification by vacuum distillation).
6. Preparation of methyl salicylate from salicylic acid. (Purification by vacuum distillation).
7. .Preparation of 4-methylacetophenone from toluene. (Purification by vacuum distillation).
8. .Preparation of phenyl acetate from phenol. (Purification by vacuum distillation)
9. Preparation of 2-chlorotoluene from *o*-toluidine. (Purification by steam distillation)
10. Preparation of 4-nitrophenol from phenol. (Purification by steam distillation/ column chromatography)
11. Preparation of fluorenone from fluorene. (Purification by column chromatography)
12. Preparation of dimethylphthalate from phthalic anhydride. (Purification by vacuum distillation)

(Minimum 8 experiments)

Note:

1. Students are expected to know (i) the planning of synthesis, effect of reaction parameters including stoichiometry, and **safety aspects including MSDS** (ii) the possible mechanism, expected spectral data (IR and NMR) of the starting material and final product.
2. Students are expected to purify the product by Steam distillation / Vacuum distillation or Column chromatography, measure its mass or volume, check the purity by TLC, determine physical constant and calculate percentage yield.

References for Practicals

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V.K. Ahluwalia and Renu Aggarwal, Universities Press India Ltd., 2000
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications
4. Systematic Identification of Organic compounds, 6th edition, R. L. Shriner, R. C. Fuson and D.Y. Curtin Wiley, New York.
5. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
6. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall
7. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
8. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
9. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
10. Vogel's Textbook of Practical Organic Chemistry, Fifth edition,2008,

B.S.Furniss, A. J.Hannaford, P. W. G. Smith, A. R. Tatchell, Pearson Education.
11. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.
12. Organic structures from spectra, L. D. Field, S. Sternhell, John R. Kalman, Wiley, 4th ed., 2011.

1. The candidate is expected to submit a journal and project certified by the Head of the Department /institution at the time of the practical examination.
2. A candidate will not be allowed to appear for the practical examination unless he/she produces a certified journal or a certificate from the Head of the institution/department stating that the journal is lost and the candidate has performed the required number of experiments satisfactorily. The list of the experiments performed by the candidate should be attached with such certificate.
3. Use of non-programmable calculator is allowed both at the theory and the practical examination.

Semester – IV
Course Code: PSCHO401
Paper - I (**Theoretical organic chemistry-II**)

Unit 1:	**Physical organic chemistry**	**[15L]**
1.1	Structural effects and reactivity**:** Linear free energy relationship (LFER) in determination of organic reaction mechanism, The Hammett equation, substituent constants, theories of substituent effects, interpretation of σ-values, reaction constants ρ, Yukawa-Tsuno equation**.**	**[7L]**
1.2	Uses of Hammett equation, deviations from Hammett equation. Dual parameter correlations, Inductive substituent constants. The Taft model, σ_I and σ_R scales, steric parameters Es and β. Solvent effects, Okamoto-Brown equation, Swain-Scott equation, Edward and Ritchie correlations, Grunwald-Winstein equation, Dimroth's E_T parameter, Solvatochromism Z-scale, Spectroscopic Correlations, Thermodynamic Implications.	**[8L]**
Unit 2	**Supramolecular chemistry**	**[15L]**
2.1	Principles of molecular associations and organizations as exemplified in biological macromolecules like nucleic acids, proteins and enzymes.	**[3L]**
2.2	Synthetic molecular receptors: receptors with molecular cleft, molecular tweezers, receptors with multiple hydrogen sites.	**[3L]**
2.3	Structures and properties of crown ethers, cryptands, cyclophanes, calixarenes, rotaxanes and cyclodextrins. Synthesis of crown ethers, cryptands and calixarenes.	**[5L]**
2.4	Molecular recognition and catalysis, molecular self-assembly.Supramolecular Polymers, Gelsand Fibres.	**[4L]**
Unit 3	**Stereochemistry- II**	**[15L]**

3.1 Racemisation and resolution of racemates including conglomerates: Mechanism of racemisation, methods of resolution: mechanical, chemical, kinetic and equilibrium asymmetric transformation and through inclusion compounds. **[3L]**

3.2 Determination of enantiomer and diastereomer composition: enzymatic method, chromatographic methods. Methods based on NMR spectroscopy: use of chiral derivatising agents (CDA), chiral solvating agents (CSA) and Lanthanide shift reagents (LSR). **[3L]**

3.3 Correlative method for configurational assignment: chemical, optical rotation, and NMR spectroscopy. **[4L]**

3.4 Molecular dissymmetry and chiroptical properties: Linearly and circularly polarized light. Circular birefringence and circular dichroism. ORD and CD curves. Cotton effect and its applications. The octant rule and the axial α–haloketone rule with applications. **[5L]**

Unit 4: Asymmetric synthesis **[15L]**

4.1 Principles of asymmetric synthesis: Introduction, the chiral pool in Nature, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions. **[3L]**

4.2 Synthesis of L-DOPA [Knowles's Mosanto process]. Asymmetric reactions with mechanism: Aldol and related reactions, Cram's rule, Felkin-Anh model, Sharpless enantioselective epoxidation, hydroxylation, aminohydroxylation, Diels-Alder reaction, reduction of prochiral carbonyl compounds and olefins. **[9L]**

4.3 Use of chiral auxiliaries in diastereoselective reductions, asymmetric amplification. Use of chiral BINOLs, BINAPs and chiral oxazolines asymmetric transformations. **[3L]**

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1 March's Advanced Organic Chemistry, Jerry March, sixth edition, 2007, John Wiley and sons.

2 A guide to mechanism in Organic Chemistry, 6th edition, 2009, Peter Sykes, Pearson education, New Delhi.

3 Advanced Organic Chemistry: Reaction Mechanisms, R. Bruckner, Academic Press (2002).

4 Mechanism and theory in Organic Chemistry, T. H. Lowry and K. C. Richardson, Harper and Row.

5 Organic Reaction Mechanism, 4th edition, V. K. Ahluvalia, R. K. Parashar, Narosa Publication.

6 Reaction Mechanism in Organic Chemistry, S.M. Mukherji, S.P. Singh, Macmillan Publishers, India.

7 Organic Chemistry, Part A and B, Fifth edition,2007, Francis A. Carey and Richard J. Sundberg, Springer.

8 Carbenes, Nitrenes and Arynes. Von T. L. Gilchrist, C. W. Rees. Th. Nelson and Sons Ltd., London 1969.

9 Organic reactive intermediates, Samuel P. MacManus, Academic Press.

10 Organic Chemistry, J. Clayden, S. Warren, N. Greeves, P. Wothers, 1st Edition, Oxford University Press (2001).
11 Organic Chemistry, Seventh Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.Advanced Organic Chemistry: Reactions & Mechanisms, second edition, B. Miller and R. Prasad, Pearson.
12 Organic reactions & their mechanisms, third revised edition, P.S. Kalsi, New Age International Publishers.
13 Organic Chemistry: Structure and Function, P. Volhardt and N. Schore, 5th Edition, 2012
14 Organic Chemistry, W. G. Solomons, C. B. Fryhle, , 9th Edition, Wiley India Pvt. Ltd.,2009.
15 Pericyclic Reactions, S. Sankararaman, Wiley VCH, 2005.
16 Advanced organic chemistry, Jagdamba Singh L. D. S. Yadav, Pragati Prakashan, 2011
17 Pericyclic reactions, Ian Fleming, Oxford university press, 1999.
18 Pericyclic reactions-A mechanistic approach, S. M. Mukherji, Macmillan Co. of India 1979.
19 Organic chemistry, 8th edition, John McMurry
20 Modern methods of Organic Synthesis, 4th Edition W. Carruthers and Iain Coldham, Cambridge University Press 2004
21 Modern physical chemistry, Eric V Anslyn, Dennis A. Dougherty, University science books,2006
22 Physical Organic Chemistry, N. S. Isaacs, ELBS/Longman
23 Stereochemistry of Carbon Compounds: Principles and Applications, D, Nasipuri, 3rd edition, New Age International Ltd.
24 Stereochemistry of Organic Compounds, Ernest L. Eliel and Samuel H. Wilen, Wiley-India edit
25 Stereochemistry, P. S. Kalsi, 4th edition, New Age International Ltd
26 Organic Stereochemistry, M. J. T. Robinson, Oxford University Press, New Delhi, India edition, 2005
27 Bioorganic, Bioinorganic and Supramolecular chemistry, P.S. Kalsi and J.P. Kalsi. New Age International Publishers
28 Supramolecular Chemistry; Concepts and Perspectives, J. M. Lehn, VCH.
29 Crown ethers and analogous compounds, M. Hiraoka, Elsevier, 1992.
30 Large ring compounds, J.A.Semlyen, Wiley-VCH, 1997.
31 Fundamentals of Photochemistry, K. K. Rohtagi-Mukherji, Wiley-Eastern
32 Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Sciertific Publication.
33 Molecular Photochemistry, N. J. Turro, W. A. Benjamin.
34 Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill
35 Photochemistry, R. P. Kundall and A. Gilbert, Thomson Nelson.
36 Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.

37 Molecular Orbitals and Organic Chemical Reactions by Ian Fleming (Wiley – A john Wiley and Sons, Ltd., Publication)

Course Code: PSCHO402
Paper - II (Synthetic organic chemistry-II)

Unit 1:	**Designing Organic Synthesis-I**	**[15L]**
1.1	**Protecting groups in Organic Synthesis:** Protection and deprotection of the hydroxyl, carbonyl, amino and carboxyl functional groups and its applications.	[3L]
1.2	**Concept of umpolung (Reversal of polarity):** Generation of acyl anion equivalent using 1,3-dithianes, methyl thiomethyl sulfoxides, cyanide ions, cyanohydrin ethers, nitro compounds and vinylated ethers.	[3L]
1.3	**Introduction to Retrosynthetic analysis and synthetic planning:** Linear and convergent synthesis; Disconnection approach: An introduction to synthons, synthetic equivalents, disconnection approach, functional group interconversions (FGI), functional group addition (FGA), functional group removal (FGR) importance of order of events in organic synthesis, one and two group C-X disconnections (1,1; 1,2; 1,3 difunctionalized compounds), selective organic transformations: chemoselectivity, regioselectivity, stereoselectivity, enantioselectivity.	[9L]
Unit 2:	**Designing Organic Synthesis-II**	**[15L]**
2.1	**General strategy:** choosing a disconnection-simplification, symmetry, high yielding steps, and recognisable starting material.	[3L]
2.2	**One group C-C Disconnections:** Alcohols (including stereoslectivity), carbonyls (including regioselectivity), Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.	[6L]
2.3	**Two group C-C Disconnections:** 1,2- 1,3- 1,4- 1,5- and 1,6- difunctionalized compounds, Diels-Alder reactions, α, β-unsaturated compounds, control in carbonyl condensations, Michael addition and Robinson annelation.	[6L]
Unit 3:	**Electro-organic chemistry and Selected methods of Organic synthesis**	**[15L]**
3.1	**Electro-organic chemistry:**	[7L]
3.1.1	Introduction: Electrode potential, cell parameters, electrolyte, working electrode, choice of solvents, supporting electrolytes.	
3.1.2	Cathodic reduction: Reduction of alkyl halides, aldehydes, ketones, nitro compounds, olefins, arenes, electro-dimerization.	
3.1.3	Anodic oxidation: Oxidation of alkylbezene, Kolbe reaction, Non-Kolbe oxidation, Shono oxidation.	
3.2	**Selected Methods of Organic synthesis**	[8L]
	Applications of the following in organic synthesis:	
3.2.1	Crown ethers, cryptands, micelles, cyclodextrins, catenanes.	
3.2.2	Organocatalysts: Proline, Imidazolidinone.	
3.2.3	Pd catalysed cycloaddition reactions: Stille reaction, Saeguse-Ito oxidation	

to enones, Negishi coupling.

3.2.4 Use of Sc(OTf), and Yb(OTf) as water tolerant Lewis acid catalyst in aldol condensation, Michael reaction, Diels-Alder reaction, Friedel – Crafts reaction.

Unit 4: Transition and rare earth metals in organic synthesis [15L]

4.1 **Introduction to basic concepts:** 18 electron rule, bonding in transition metal complexes, C-H activation, oxidative addition, reductive elimination, migratory insertion. [3L]

4.2 **Palladium in organic synthesis:** π-bonding of Pd with olefins, applications in C-C bond formation, carbonylation, alkene isomerisation, cross-coupling of organometallics and halides. Representative examples: Heck reaction, Suzuki-Miayura coupling, Sonogashira reaction and Wacker oxidation. Heteroatom coupling for bond formation between aryl/vinyl groups and N, S, or P atoms. [5L]

4.3 **Olefin metathesis** using Grubb's catalyst. [1L]

4.4 **Application of Ni, Co, Fe, Rh, and Cr carbonyls** in organic synthesis. [4L]

4.5 **Application of samarium iodide** including reduction of organic halides, aldehydes and ketones, α-functionalised carbonyl and nitro compounds. [1L]

4.6 **Application of Ce(IV)** in synthesis of heterocyclic quinoxaline derivatives and its role as a de-protecting agent**.** [1L]

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- **Advanced Organic Chemistry,** Part A and Part B: Reaction and Synthesis, Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer Verlag
- **Modern Methods of Organic Synthesis,** 4th Edition, W. Carruthers and Iain Coldham, Cambridge University Press, 2004.
- **Chem.Rev. 2002, 102, 2227-2302, Rare Earth Metal Triflates in Organic Synthesis,** S. Kobayashi, M. Sugiura, H. Kitagawa, and W.W.L. Lam.
- **Organic Chemistry,** Clayden Greeves Warren and Wothers, Oxford Press (2001).
- **Moder Organic Synthesis: An Introduction,** G.S. Zweifel and M.H. Nantz, W.H. Freeman and Company, (2007).
- **Advanced Organic Chemistry: Reaction Mechanism,** R. Bruckner, Academic Press (2002).
- **Principles of Organic Synthesis,** R.O.C. Norman & J. M. Coxon, 3rd Edn., Nelson Thornes
- **Organic Chemistry,** 7th Edn, R. T .Morrison, R. N. Boyd, & S. K. Bhattacharjee, Pearson
- **Strategic Applications of Name Reactions in Organic Synthesis**, L. Kurti & B. Czako (2005), Elsevier Academic Press

- **Advanced Organic Chemistry: Reactions & Mechanisms,** 2nd Edn., B. Miller & R. Prasad, Pearson
- **Organic reactions and their mechanisms,** 3rd revisededition, P.S. Kalsi, New Age International Publishers
- **Organic Synthesis: The Disconnection Approach,** Stuart Warren, John Wiley & Sons, 2004
- **Name Reactions and Reagents in Organic Synthesis,** 2nd Edn., Bradford P. Mundy, Michael G. Ellard, and Frank Favoloro, Jr., Wiley-Interscience
- **Name Reactions,** Jie Jack Lie, 3rd Edn., Springer
- **Organic Electrochemistry,** H. Lund, and M. Baizer, 3rd Edn., Marcel Dekker.

Course Code: PSCHO403
Paper - III (Natural products and heterocyclic chemistry)

Unit 1:	**Natural products-III**	**[15L]**
1.1	**Steroids:** General structure, classification. Occurrence, biological role, important structural and stereochemical features of the following: corticosteroids, steroidal hormones, steroidal alkaloids, sterols and bile acids.	[5L]
1.2	Synthesis of 16-DPA from cholesterol and plant sapogenin.	[2L]
1.3	Synthesis of the following from 16-DPA: androsterone, testosterone, oestrone, oestriol, oestradiol and progesterone.	[5L]
1.4	Synthesis of cinerolone, jasmolone, allethrolone, exaltone and muscone.	[3L]
Unit 2:	**Natural products-IV**	**[15L]**
2.1	**Vitamins:** Classification, sources and biological importance of vitamin B_1, B_2, B_6, folic acid, B_{12}, C, D_1, E (α-tocopherol), K_1, K_2, H (β- biotin). Synthesis of the following: Vitamin A from β-ionone and bromoester moiety. Vitamin B_1 including synthesis of pyrimidine and thiazole moieties Vitamin B_2 from 3, 4-dimethylaniline and D(-)ribose Vitamin B_6 from: 1) ethoxyacetylacetone and cyanoacetamide, 2) ethyl ester of N-formyl-DL-alanine (Harris synthesis) Vitamin E (α-tocopherol) from trimethylquinol and phytyl bromide Vitamin K_1 from 2-methyl-1, 4-naphthaquinone and phytol.	[5L]
2.2	**Antibiotics:** Classification on the basis of activity. Structure elucidation, spectral data of penicillin-G, cephalosporin-C and chloramphenicol. Synthesis of chloramphenicol (from benzaldehyde and β-nitroethanol) penicillin-G and phenoxymethylpenicillin from D-penicillamine and t-butyl phthalimide malonaldehyde (synthesis of D-penicillamine and t-butyl phthalimide malonaldehyde expected).	[6L]
2.3	**Naturally occurring insecticides:** Sources, structure and biological properties of pyrethrums (pyrethrin I), rotenoids (rotenone). Synthesis of pyrethrin I.	[2L]
2.4	**3.4 Terpenoids**: Occurrence, classification, structure elucidation,	[2L]

stereochemistry, spectral data and synthesis of zingiberene .

Unit 3: Heterocyclic compounds-I **[15L]**

Heterocyclic compounds: Introduction, classification, Nomenclature of heterocyclic compounds of monocyclic (3-6 membered) (Common, systematic (Hantzsch-Widman) and replacement nomenclature)

Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyridazines, pyrimidine, pyrazines and oxazines.

Unit 4: Heterocyclic compounds-II **[15L]**

Nomenclature of heterocyclic compounds of bicyclic/tricyclic (5-6 Membered) fused heterocycles (up to three hetero atoms)**.** (Common, systematic (Hantzsch-Widman) and replacement nomenclature)

Nucleophilic ring opening reactions of oxiranes, aziridines, oxetanes and azetidines.

Structure, reactivity, synthesis and reactions of coumarins, quinoxalines, cinnolines, indole, benzimidazoles, benzoxazoles, benzothiazoles, Purines and acridines.

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1. Natural product chemistry, A mechanistic, biosynthetic and ecological approach, Kurt B.G. Torssell, Apotekarsocieteten – Swedish Pharmaceutical Press.
2. Natural products chemistry and applications, Sujata V. Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House, 2011.
3. Organic Chemistry Natural Products Volume-II, O. P. Agarwal, Krishna Prakashan, 2011.
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9. Heterocyclic Chemistry, J. A. Joule and G. F. Smith, ELBS, 2nd edition, 1982.
10. The Conformational Analysis of Heterocyclic Compounds, F.G. Riddell, Academic Press,1980.
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15. Stereoselective Synthesis: A Practical Approach, M. Nogradi, Wiley-VCH, 1995.
16. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
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23. **The structure and total synthesis of 5-Vetivone, J. A. Marshall and P. C. Johnson, J. Org. Chem., 35, 192 (1970).**
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27. **Synthesis of (±)-4-demethoxydaunomycinone,A. V. Rama Rao , G. Venkatswamy , S. M. Javeed M. , V. H. Deshpande, B. Ramamohan Rao, J. Org. Chem., 1983, 48 (9), 1552.**
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43. Introduction to spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, 4th ed., 2009.
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46. Alkaloids,V.K. Ahuluwalia,Ane Books Pvt.Ltd.
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48. Structure Determination of Organic Compounds, EPretsch, P. Buhlmann, C.Affolter, Springer

Course Code: PSCHOOC-I 404
Paper – IV (INTELLECTUAL PROPERTY RIGHTS & CHEMINFORMATICS)

Unit 1: **[15L]**

Introduction to Intellectual Property: [2L]

Historical Perspective, Different types of IP, Importance of protecting IP.

Patents: [5L]

Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Health care-balancing promoting innovation with public health, Software patents and their importance for India.

Industrial Designs: [2L]

Definition, How to obtain, features, International design registration.

Copyrights: [2L]

Introduction, How to obtain, Differences from Patents.

Trade Marks: [2L]

Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, trade names etc.

Geographical Indications: [2L]

Definition, rules for registration, prevention of illegal exploitation, importance to India.

Unit 2: [15L]

Trade Secrets: [2L]

Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

IP Infringement issue and enforcement: [2L]

Role of Judiciary, Role of law enforcement agencies – Police, Customs etc.

Economic Value of Intellectual Property: [2L]

Intangible assests and their valuation, Intellectual Property in the Indian context – Various Laws in India Licensing and Technology transfer.

Different International agreements:

(a) World Trade Organization (WTO): [5L]

(i) General Agreement on Tariffs and Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement

(ii) General Agreement on Trade Related Services (GATS) Madrid Protocol.

(iii) Berne Convention

(iv) Budapest Treaty

(b) Paris Convention [6L]

WIPO and **TRIPS, IPR** and Plant Breeders Rights, IPR and Biodiversity.

Unit III: [15L]

Introduction to Cheminformatics: [5L]

History and evolution of cheminformatics, Use of Cheminformatics, Prospects of cheminformatics, Molecular modeling and structure elucidation.

Representation of molecules and chemical reactions: [5L]

Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

Searching Chemical Structures: [5L]

Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

Unit IV: [15L]

Applications:

Prediction of Properties of Compound, Linear Free Energy Relations, Quantitative Structure – Property Relations, Descriptor Analysis, Model Building, Modeling Toxicity, Structure – Spectra correlations, Prediction NMR, IR and Mass spectra, Computer Assisted Structure elucidations, Computer assisted Synthesis Design, Introduction to drug design, Target Identification and Validation, Lead Finding and Optimization, analysis of HTS data, Virtual Screening, Design of Combinatorial Libraries, Ligand-based and Structure based Drug design, Application of Cheminformatics in Drug Design.

REFERENCES:

1. Andrew R. Leach & Valerie J. Gillet (2007) *An Introduction to Cheminformatics.* Springer: The Netherlands.
2. Gasteiger, J. & Engel, T. (2003) *Cheminformatics: A textbook*. Wiley–VCH
3. Gupta, S. P. *QSAR and Molecular Modeling.* Springer-Anamaya Pub.: New Delhi.

Course Code: PSCHOOC-II 404

PAPER – IV: RESEARCH METHODOLOGY

Unit 1: [15L]

Print: [5L]

Primary, Secondary and Tertiary sources.

Journals:

Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

Digital: [5L]

Web sources, E-journals, Journal access, TOC alerts, Hot articles, Citation Index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki-databases, ChemSpider, Science Direct, SciFinder, Scopus.

Information Technology and Library Resources: [5L]

The Internet and World wide web, Internet resources for Chemistry, finding and citing published information.

Unit II: DATA ANALYSIS [15L]

The Investigative Approach:

Making and recording Measurements, SI units and their use, Scientific methods and design of experiments.

Analysis and Presentation of Data:

Descriptive statistics, choosing and using statistical tests, Chemometrics, Analysis of Variance (ANOVA), Correlation and regression, curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, general polynomial fitting, linearizing transformations, exponential function fit, r and its abuse, basic aspects of multiple linear regression analysis.

Unit III: METHODS OF SCIENTIFIC RESEARCH AND WRITING [15L]

SCIENTIFIC PAPERS

Reporting practical and project work, Writing literature surveys and reviews, organizing a poster display, giving an oral presentation.

Writing Scientific Papers:

Justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work, writing ethics, avoiding plagiarism.

Unit IV: CHEMICAL SAFETY & ETHICAL HANDLING OF CHEMICALS [15L]

Safe working procedure and protective environment, protective apparel, emergency procedure, first aid, laboratory ventilation, safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric pressur, safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

REFERENCES:

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J., & Jones, A., (2011), *Practical skills in Chemistry*, 2nd Ed., Prentice Hall, Harlow.
2. Hibbert, D. B. & Gooding, J. J. (2006) *Data Analysis for Chemistry* Oxford University Press.
3. Topping, J., (1984) *Errors of Observation and their Treatment* 4th Ed., Chapman Hill, London.
4. Harris, D. C. (2007) *Quantative Chemical Analysis* 6th Ed., Freeman Chapters 3-5
5. Levie, R. De. (2001) *How to use Excel in Analytical Chemistryand in general scientific data analysis* Cambridge Universty Press.
6. Chemical Safety matters – IUPAC-IPCS, (1992) Cambridge University Press.
7. OSU Safety manual 1.01

Semester IV: Practicals
Course code: PSCHO4P1

Two steps preparations

1. Acetophenone → Acetophenone phenyl hydrazine → 2-phenyl

indole.

2. 2-naphthol → 1-phenyl azo-2-naphthol → 1-amino-2-naphthol.
3. Cyclohexanone → cyclohexanone oxime → Caprolactum.
4. Hydroquinone → hydroquinone diacetate → 2,5-dihydroxyacetophenone.
5. 4-nitrotoluene → 4-nitrobenzoic acid → 4-aminobenzoic acid.
6. *o*-nitroaniline → *o*-phenylene diamine → Benzimidazole.
7. Benzophenone → benzophenone oxime → benzanilide.
8. *o*-chlorobenzoic acid → N-phenyl anthranilic acid → acridone.
9. Benzoin → benzil → benzilic acid.
10. Phthalic acid → phthalimide → anthranilic acid.
11. Resorcinol → 4-methyl-7-hydroxy coumarin → 4-methyl-7-acetoxy coumarin.
12. Anthracene → anthraquinone → anthrone.

(Minimum 8 experiments)

Note:

1. Students are expected to know (i) the planning of synthesis, effect of reaction parameters including stoichiometry, and **safety aspects including MSDS** (ii) the possible mechanism, expected spectral data (IR and NMR) of the starting material and final product.
2. Students are expected to purify the product by recryllization, measure its mass or volume, check the purity by TLC, determine physical constant and calculate percentage yield.

Course code: PSCHO4P2

Session-I: Combined spectral identification: Interpretation of spectral data of organic compounds (UV, IR, PMR, CMR and Mass spectra).

A student will be given UV, IR, PMR, CMR, and Mass spectra of a compound from which preliminary information should be reported within first half an hour of the examination without referring to any book/reference material. The complete structure of the compound may then be elucidated by referring to any standard text-book/reference material etc (**Minimum 8 spectral analysis).**

Session-II: Project evaluation

References for Practicals

1. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis- V. K. Ahluwalia and Renu Aggarwal, Universities Press India Ltd., 2000
2. Advanced Practical Organic Chemistry – N. K. Vishnoi, Third Addition, Vikas Publishing House PVT Ltd
3. Systematic Laboratory Experiments in Organic Synthesis- A. Sethi, New Age International Publications
4. Systematic Identification of Organic compounds, 6th edition, R. L. Shriner, R. C. Fuson and D.Y. Curtin Wiley, New York.
5. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
6. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall

7. Macro-scale and Micro-scale Organic Experiments, K. L. Williamson, D. C. Heath.
8. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
9. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clark, Adward Arnold.
10. Vogel's Textbook of Practical Organic Chemistry, Fifth edition,2008, B.S.Furniss, A. J.Hannaford, P. W. G. Smith, A. R. Tatchell, Pearson Education.
11. Laboratory Manual of Organic Chemistry, Fifth edition, R K Bansal, New Age Publishers.
12. Organic structures from spectra, L. D. Field, S. Sternhell, John R. Kalman, Wiley, 4th ed., 2011.

1. The candidate is expected to submit a journal and project certified by the Head of the Department /institution at the time of the practical examination.
2. A candidate will not be allowed to appear for the practical examination unless he/she produces a certified journal or a certificate from the Head of the institution/department stating that the journal is lost and the candidate has performed the required number of experiments satisfactorily. The list of the experiments performed by the candidate should be attached with such certificate.
3. Use of non-programmable calculator is allowed both at the theory and the practical examination.

University of Mumbai

Revised Syllabus of Courses
of
Master of Commerce (M.Com) Programme
at
Second Year
Semester III and IV

Under Choice Based Credit, Grading and Semester System

(To be implemented from Academic Year 2017-2018)

Faculty of Commerce

Master of Commerce (M.Com) Programme

Under Choice Based Credit, Grading and Semester System

Course Structure

M.Com II

(To be implemented from Academic Year- 2017-2018)

No. of Courses	Semester III	Credits	No. of Courses	Semester IV	Credits
1	***Elective Courses (EC)***		***1***	***Elective Courses (EC)***	
1,2 and 3	*Any one group of courses from the following list of the courses (Group – A/B/C/D/E)	**18**	1,2 and 3	**Any one group of courses from the following list of the courses (Group – A/B/C/D/E)	**18**
2	✓ ***Project Work***		***2***	✓ ***Project Work***	
4	Project Work - I	**06**	4	Project Work - II	**06**
	Total Credits	**24**		**Total Credits**	**24**

✓ ***Note:*** *Project work is considered as a special course involving application of knowledge in solving/ analyzing/ exploring a real life situation/ difficult problem. Project work would be of 06 credits. A project work may be undertaken in any area of Elective Courses*

Sr. No.	Modules / Units
1	**Overview of Indian Society**
	Understand the multi-cultural diversity of Indian society through its demographic composition: population distribution according to religion, caste, and gender; Appreciate the concept of linguistic diversity in relation to the Indian situation; Understand regional variations according to rural, urban and tribal characteristics; Understanding the concept of diversity as difference
2	**Concept of Disparity- 1**
	Understand the concept of disparity as arising out of stratification and inequality; Explore the disparities arising out of gender with special reference to violence against women, female foeticide (declining sex ratio), and portrayal of women in media;Appreciate the inequalities faced by people with disabilities and understand the issues of people with physical and mental disabilities
3	**Concept of Disparity-2**
	Examine inequalities manifested due to the caste system and inter-group conflicts arising thereof; Understand inter-group conflicts arising out of communalism; Examine the causes and effects of conflicts arising out of regionalism and linguistic differences
4	**The Indian Constitution**
	Philosophy of the Constitution as set out in the Preamble; The structure of the Constitution-the Preamble, Main Body and Schedules; Fundamental Duties of the Indian Citizen; tolerance, peace and communal harmony as crucial values in strengthening the social fabric of Indian society; Basic features of the Constitution
5	**Significant Aspects of Political Processes**
	The party system in Indian politics; Local self-government in urban and rural areas; the 73rd and 74th Amendments and their implications for inclusive politics; Role and significance of women in politics

Topics for Project Guidance: Growing Social Problems in India:

- *Substance abuse- impact on youth & challenges for the future*
- *HIV/AIDS- awareness, prevention, treatment and services*
- *Problems of the elderly- causes, implications and response*
- *Issue of child labour- magnitude, causes, effects and response*
- *Child abuse- effects and ways to prevent*
- *Trafficking of women- causes, effects and response*

Note:

Out of the 45 lectures allotted for 5 units for Semester I, about 15 lectures may be allotted for project guidance

Academic Council : 2/2017
Item No :

UNIVERSITY OF MUMBAI

Syllabus for Sem III & IV

Program: M.Sc.

Course: Biotechnology

(Credit Based Semester and Grading System with effect

Semester IV Practicals

It is mandatory for students to undergo Hands-on Project training in a established laboratory for 4-6 months; This should involve one or more relavant instrumentation technique. Thesis on the same to be evaluated by the guide alternatively by internal examiner for 50M based on the students performace, written matter and experimentation. A certificate / marklist to be appended with the thesis. External examiner to assess for 50M as a Presentation during practical exams. Marks alloted by Internal examnier would be scaled down if required as per university guidelines.

Sr No.	Experiment
1	Multiple alignment - Phylogenetic tree
2	BLAST - orthologs and paralogs , homologs
3	Motif finding
4	KEGG
5	Structure of proteins - identification of chains helices, special groups, metal ions etc. CATH / SCOP classification of a given protein
6	Nanoparticles - synthesis chemical and biological methods;Spectroscopic analysis
7	Bioremediation- isolation of metal tolerant organisms & study their growth characteristics and pattern
8	Composting – physical & chemical parameters
9	GMO - Validation - kit based/ demo

PSBTP401	**Nanotechnology**	**2**	**4**
PSBTP402	**GMO and environment**	**2**	**4**
PSBTP403	**Bioinformatics**	**2**	**4**
PSBTP404	**Biostatistics**	**2**	**4**

University of Mumbai

No. UG/23 of 2020-21

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, the Head University Departments and Directors of the recognized Institutions in Science & Technology Faculty is invited to the syllabus uploaded Academic Authority Unit which was accepted by the Academic Council at its meeting held on 7th April, 2014 vide item No. 4.39 relating to the revised syllabus as per the (CBGS) of M.Sc. in Information Technology (Sem. III &IV).

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Information Technology at its meeting held on 17th April, 2020 vide Item No.1 and subsequently made by the Board of Deans at its meeting held on 20th July, 2020 vide item No. 48 have been accepted by the Academic Council at its meeting held on 23rd July, 2020 vide item No. 4.100 and that in accordance therewith, the revised syllabus as per the (CBCS) of M.Sc. Part-II (Sem-III & IV) in Information Technology has been brought into force with effect from the academic year 2020-21 accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
(11th November, 2020
To

(Dr. Vinod Patil)
I/c REGISTRAR

The Principals of the affiliated Colleges, the Head University Departments and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.100/23/07/2020

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No. UG/23 -A of 2020-21 MUMBAI-400 032 11th November, 2020

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Ad-hoc Board of Studies in Information Technology,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-ordinator, University Computerization Centre,

(Dr. Vinod Patil)
I/c REGISTRAR

less than 10%. The marks can be awarded as per the impact factor of the journal, quality of the paper, importance of the contents published, social value.

External Examination: (60 marks)

	All questions are compulsory	
Q1	**(Based on Unit 1) Attempt *any two* of the following:**	**12**
a.		
b.		
c.		
d.		
Q2	**(Based on Unit 2) Attempt *any two* of the following:**	**12**
Q3	**(Based on Unit 3) Attempt *any two* of the following:**	**12**
Q4	**(Based on Unit 4) Attempt *any two* of the following:**	**12**
Q5	**(Based on Unit 5) Attempt *any two* of the following:**	**12**

Practical Evaluation (50 marks)

A Certified copy of hard-bound journal is essential to appear for the practical examination.

1.	**Practical Question 1**	**20**
2.	**Practical Question 2**	**20**
3.	**Journal**	**5**
4.	**Viva Voce**	**5**

OR

1.	**Practical Question**	**40**
2.	**Journal**	**5**
3.	**Viva Voce**	**5**

Project Documentation and Viva Voce Evaluation

The documentation should be checked for plagiarism and as per UGC guidelines, should be less than 10%.

1.	**Documentation Report (Chapter 1 to 4)**	**20**
2.	**Innovation in the topic**	**10**
3.	**Documentation/Topic presentation and viva voce**	**20**

Project Implementation and Viva Voce Evaluation

1.	**Documentation Report (Chapter 5 to last)**	**20**
2.	**Implementation**	**10**
3.	**Relevance of the topic**	**10**
4.	**Viva Voce**	**10**

Appendix – 1

Project Documentation and Viva-voce (Semester III) and Project Implementation and Viva-Voce (Semester IV)

Goals of the course Project Documentation and Viva-Voce

The student should:

- be able to apply relevant knowledge and abilities, within the main field of study, to a given problem
- within given constraints, even with limited information, independently analyse and discuss complex inquiries/problems and handle larger problems on the advanced level within the main field of study
- reflect on, evaluate and critically review one's own and others' scientific results
- be able to document and present one's own work with strict requirements on structure, format, and language usage
- be able to identify one's need for further knowledge and continuously develop one's own knowledge

To start the project:

- Start thinking early in the programme about suitable projects.
- Read the instructions for the project.
- Attend and listen to other student´s final oral presentations.
- Look at the finished reports.
- Talk to senior master students.
- Attend possible information events (workshops / seminars / conferences etc.) about the related topics.

Application and approval:

- Read all the detailed information about project.
- Finalise finding a place and supervisor.
- Check with the coordinator about subject/project, place and supervisor.
- Write the project proposal and plan along with the supervisor.
- Fill out the application together with the supervisor.
- Hand over the complete application, proposal and plan to the coordinator.
- Get an acknowledgement and approval from the coordinator to start the project.

During the project:

- Search, gather and read information and literature about the theory.

- Document well the practical work and your results.
- Take part in seminars and the running follow-ups/supervision.
- Think early on about disposition and writing of the final report.
- Discuss your thoughts with the supervisor and others.
- Read the SOP and the rest you need again.
- Plan for and do the mid-term reporting to the coordinator/examiner.
- Do a mid-term report also at the work-place (can be a requirement in some work-places).
- Write the first draft of the final report and rewrite it based on feedback from the supervisor and possibly others.
- Plan for the final presentation of the report.

Finishing the project:
- Finish the report and obtain an OK from the supervisor.
- Ask the supervisor to send the certificate and feedback form to the coordinator.
- Attend the pre-final oral presentation arranged by the Coordinator.
- Rewrite the final report again based on feedback from the opponents and possibly others.
- Prepare a title page and a popular science summary for your report.
- Send the completed final report to the coordinator (via plagiarism software)
- Rewrite the report based on possible feedback from the coordinator.
- Appear for the final exam.

Project Proposal/research plan
- The student should spend the first 1-2 weeks writing a 1-2 pages project plan containing:
  - Short background of the project
  - Aims of the project
  - Short description of methods that will be used
  - Estimated time schedule for the project
- The research plan should be handed in to the supervisor and the coordinator.
- Writing the project plan will help you plan your project work and get you started in finding information and understanding of methods needed to perform the project.

Project Documentation
The documentation should contain:
- Introduction - that should contain a technical and social (when possible) motivation of the project topic.
- Description of the problems/topics.
- Status of the research/knowledge in the field and literature review.
- Description of the methodology/approach. (The actual structure of the chapters here depends on the topic of the documentation.)
- Results - must always contain analyses of results and associated uncertainties.
- Conclusions and proposals for the future work.
- Appendices (when needed).
- Bibliography - references and links.

For the master's documentation, the chapters cannot be dictated, they may vary according to the type of project. However, in Semester III Project Documentation and Viva Voce must contain at least 4 chapters (Introduction, Review of Literature, Methodology / Approach, Proposed Design / UI design, etc. depending on the type of project.) The Semester III report should be spiral bound.

In Semester IV, the remaining Chapters should be included (which should include Experiments performed, Results and discussion, Conclusions and proposals for future work, Appendices) and Bibliography - references and links. Semester IV report should include all the chapters and should be hardbound.

UNIVERSITY OF MUMBAI
No. UG/53 of 2018-19

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Humanities Faculty is invited to this office circular No. UG/207 of 2010, dated 21st July, 2010 relating to syllabus of Bachelor of Arts.

They are hereby informed that the recommendations made by the Board of Studies in Politics at its meeting held on 4th June, 2018 have been accepted by the Academic Council at its meeting held on 14th June, 2018 **vide** item No. 4.2 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.A. in Politics – Sem V & VI has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
4th July, 2018

To

The Principals of the affiliated Colleges and Directors of the recognized Institutions in Humanities Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.2/14/06/2018

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No. UG/53 -A of 2018 MUMBAI-400 032 4th July, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Humanities,
2) The Chairman, Board of Studies in Politics,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Professor-cum-Director, Institute of Distance and Open Learning (IDOL),
6) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

6A

Politics Paper VI A: Political Process in Modern Maharashtra
Semester V: Politics of Modern Maharashtra
Theory – 80 marks + Project – 20 marks = Total 100 marks

No. of Lectures
(Total 45)

Module 1: Historical Background 11
1.1 Evolution of the idea of Maharashtra
1.2 Nationalist Movement and Social Reform Movement
1.3 Sanyukta Maharashtra Movement

Module 2: Sub-regionalism, Regional Disparity and Development 12
2.1 Konkan, Marathwada &Vidarbha
2.2 Dandekar Committee Report
2.3 Statutory Development Boards

Module 3: Political Institutions in Maharashtra 12
3.1 State Legislature: Composition and Functions
3.2 Chief Minister and Council of Ministers: Role
3.3 High Court and Subordinate Courts

Module 4: Caste and Politics in Maharashtra 10
4.1 Dominant Caste Politics
4.2 Dalit Politics
4.3 OBC Politics

One theory question paper of 80 marks at the end of the semester, consisting 4 compulsory questions of 20 marks each with internal options for each question – i.e. Q. 1a or Q. 1b.

Project reports – (20 marks) - will be collected and assessed at college level by respective subject teachers, on or before a fixed date, well before the beginning of semester end theory exam. The date will be decided by the Subject teachers in respective colleges. Topics for projects should be based on the semester syllabus.

List of topics for projects

(This is not a comprehensive list and teachers are free to design projects based on the syllabus)

1. Reviews of books related to politics of Maharashtra.
2. Interviews of politicians and administrators.
3. Reviews of biographies and autobiographies of influential leaders.
4. Review of social welfare schemes
5. Study of sub regions – Konkan, Marathwada, Vidarbha, Western Maharashtra
6. Legislative process

UNIVERSITY OF MUMBAI

No. UG/91 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Commerce & Management Faculty is invited to this office Circular No. UG/28 of 2015, dated 22nd July, 2015 relating to syllabus of Bachelor of Commerce (Accounting and Finance) degree programme.

Their attention is also invited to University Circular No. UG/106 of 2016-17 dated 25th October, 2016 for F.Y.B.Com. (Accounting & Finance) Sem. I & II and University Circular No. UG/166 of 2017-18 dated 8th August, 2017 for S.Y.B.Com. (Accounting & Finance) Sem. III & IV respectively.

They are hereby informed that the recommendations made by the Board of Studies in Accountancy at its meeting held on 28th February, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.42 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Com. in Accountancy (Accounting and Finance) (Sem. V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
27th July, 2018

To

The Principals of the affiliated Colleges and Directors of the recognized Institutions in Commerce & Management Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.42/05/05/2018

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No. UG/ 91 -A of 2018 MUMBAI-400 032 27th July, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Commerce & Management,
2) The Director, Board of Examinations and Evaluation,
3) The Director, Board of Students Development,
4) The Professor-cum-Director, Institute of Distance and Open Learning (IDOL),
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

University of Mumbai

Revised Syllabus
and
Question Paper Pattern
of Courses of
B.Com. (Accounting and Finance)
Programme at
Third Year
Semester V and VI

Under Choice Based Credit, Grading and Semester *System*

(To be implemented from Academic Year 2018-2019)

Board of Studies-in-Accountancy

B.Com. (Accounting and Finance) Programme

Under Choice Based Credit, Grading and Semester System

T.Y.B.Com. (Accounting and Finance)

(To be implemented from Academic Year 2018-2019)

No. of Courses	Semester V	Credits	No. of Courses	Semester VI	Credits
1	***Elective Courses (EC)***		***1***	***Elective Courses (EC)***	
1,2,3 &4	*Any four courses from the following list of the courses	**12**	1,2,3 &4	**Any four courses from the following list of the courses	**12**
2	***Core Courses (CC)***		***2***	***Core Courses (CC)***	
5	Financial Accounting - V	**04**	5	Financial Accounting - VII	**04**
6	Financial Accounting - VI	**04**	6	Project Work-II	**04**
	Total Credits	**20**		**Total Credits**	**20**

- ✓ ***Note:*** *Project work is considered as a special course involving application of knowledge in solving/analyzing/exploring a real life situation/ difficult problem. Project work would be of 04 credits each. A project work may be undertaken in any area of Elective Courses/ Study Area*

****List of Elective Courses for Semester V (Any Four)***		*****List of Elective Courses for Semester VI (Any Four)***	
01	Cost Accounting - III	01	Cost Accounting - IV
02	Financial Management - II	02	Financial Management - III
03	Taxation - IV (Indirect Taxes - II)	03	Taxation - V (Indirect Taxes- III)
04	International Finance	04	Security Analysis and Portfolio Management
05	Financial Analysis and Business Valuation	05	Management Control Systems
06	Management -II (Management Applications)	06	Economics Paper – III (Indian Economy)
Note: Course selected in Semester V will continue in Semester VI			

UNIVERSITY OF MUMBAI
No. UG/ 89 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Commerce & Management Faculty is invited to this office Circular No. UG/21 of 2016-17, dated 30th June, 2016 relating to syllabus of Bachelor of Management Studies (B.M.S.) degree course.

Their attention is also invited to University Circular No. UG/109 of 2016-17 dated 25th October, 2016 for F.Y.B.M.S. (Sem. I & II) and University Circular No. UG/261 of 2017-18 dated 23rd October, 2017 for S.Y. B.M.S. (Sem. III & IV) respectively.

They are hereby informed that the recommendations made by the Board of Studies in Business Management at its meeting held on 28th February, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.44 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.M.S. (Sem. V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
27th July, 2018

To

The Principals of the affiliated Colleges and Directors of the recognized Institutions in Commerce & Management Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.44/05/05/2018

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No. UG/ 89 -A of 2018 MUMBAI-400 032 27th July, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Commerce & Management,
2) The Director, Board of Examinations and Evaluation,
3) The Director, Board of Students Development,
4) The Professor-cum-Director, Institute of Distance and Open Learning (IDOL),
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

University of Mumbai

Revised Syllabus
and
Question Paper Pattern
of Courses
of
Bachelor of Management Studies (BMS) Programme at Third Year
Semester V and VI

Under Choice Based Credit, Grading and Semester System

(To be implemented from Academic Year- 2018-2019)

Board of Studies-in-Business Management, University of Mumbai

Bachelor of Management Studies (BMS) Programme

Under Choice Based Credit, Grading and Semester System

TYBMS

(To be implemented from Academic Year- 2018-2019)

No. of Courses	Semester V	Credits	No. of Courses	Semester VI	Credits
1	***Elective Courses (EC)***		***1***	***Elective Courses (EC)***	
1,2,3 & 4	*Any four courses from the following list of the courses	**12**	1,2,3 & 4	**Any four courses from the following list of the courses	**12**
2	***Core Course (CC)***		***2***	***Core Course (CC)***	
5	Logistics & Supply Chain Management	**04**	5	Operation Research	**04**
3	**Ability Enhancement Course (AEC)**		**3**	**Ability Enhancement Course (AEC)**	
6	Corporate Communication & Public Relations	**04**	6	Project Work	**04**
	Total Credits	**20**		**Total Credits**	**20**

✓ ***Note:*** *Project work is considered as a special course involving application of knowledge in solving/analysing/exploring a real life situation/ difficult problem. Project work would be of 04 credits. A project work may be undertaken in any area of Elective Courses/ study area selected*

****List of group of Elective Courses(EC) for Semester V (Any Four)***		***** List of group of Elective Courses(EC) for Semester VI (Any Four)***	
Group A: Finance Electives			
1	Investment Analysis& Portfolio Management	1	International Finance
2	Commodity & Derivatives Market	2	Innovative Financial Services
3	Wealth Management	3	Project Management
4	Financial Accounting	4	Strategic Financial Management
5	Risk Management	5	Financing Rural Development
6	Direct Taxes	6	Indirect Taxes
Group B:Marketing Electives			
1	Services Marketing	1	Brand Management
2	E-Commerce & Digital Marketing	2	Retail Management
3	Sales & Distribution Management	3	International Marketing
4	Customer Relationship Management	4	Media Planning & Management
5	Industrial Marketing	5	Sports Marketing
6	Strategic Marketing Management	6	Marketing of Non Profit Organisation
Group C: Human Resource Electives			
1	Finance for HR Professionals & Compensation Management	1	HRM in Global Perspective
2	Strategic Human Resource Management & HR Policies	2	Organisational Development
3	Performance Management & Career Planning	3	HRM in Service Sector Management
4	Industrial Relations	4	Workforce Diversity
5	Talent & Competency Management	5	Human Resource Accounting & Audit
6	Stress Management	6	Indian Ethos in Management
Note: Group selected in Semester III will continue in Semester V &Semester VI			

UNIVERSITY OF MUMBAI
No. UG/ 61 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular Nos. UG/126 of 2011, dated 13th June, 2011 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the I/c Dean, Faculty of Science & Technology at its meeting held on 8th June, 2018 have been accepted by the Academic Council at its meeting held on 14th June, 2018 **vide** item No. 4.38 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Bio-Technology (Sem - V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
6th ~~June~~ July, 2018

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.38/14/06/2018

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No. UG/ 61 -A of 2018 MUMBAI-400 032 6th ~~June~~ July, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Director, Board of Examinations and Evaluation,
3) The Director, Board of Students Development,
4) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

UNIVERSITY OF MUMBAI

Revised Syllabus for T.Y.B.Sc.
Programme- B.Sc.
Course- Biotechnology (USBT)
(Third Year – Sem. V & VI)

(Credit Based Semester and Grading System with effect from the academic year 2018-2019)

TYBSC Biotechnology Course Structure

Semester V

Course code USBT	Title	Theory /Practical	Marks	Credits	Nos of Lectures & Practical
501	Cell biology	Theory	100	2.5	60
502	Medical Microbiology & Instrumentation	Theory	100	2.5	60
503	Genomes and Molecular Biology	Theory	100	2.5	60
504	Marine Biotechnology	Theory	100	2.5	60
P501+502	Cell biology+ Medical Microbiology & Instrumentation	Practical	100	3.0	72
P503+504	Genomes and Molecular Biology+ Marine Biotechnology	Practical	100	3.0	72
Applied Component	Biosafety	Theory	100	2.0	48
	Biosafety	Practical	100	2.0	48
	TOTAL		**800**	**20**	**480**

Semester VI

Course code USBT	Title	Theory/ Practical	Marks	Credits	Nos of Lectures & Practical
601	Biochemistry	Theory	100	2.5	60
602	Industrial Microbiology	Theory	100	2.5	60
603	Pharmacology and Neurochemistry	Theory	100	2.5	60
604	Environmental Biotechnology	Theory	100	2.5	60
P 601-P 602	Biochemistry& Industrial Microbiology	Practical	100	3	72
P 603-P 604	Pharmacology - Neurochemistry and Environmental Biotechnology (50M)+ Project work (50M)	Practical	100	3	72
Applied component	Agribiotechnology	Theory	100	2.0	48
Applied component	Agribiotechnology	Practical	100	2.0	48
	TOTAL		**800**	20	**480**

Teaching pattern:

One (01) Credit would be of thirty- forty (30-40) learning hours; of this more than fifty percent of the time will be spent on class room instructions including practical as prescribed by the University. Rest of the time spent invested for assignments, projects, journal writing, case studies, library work, industrial visits, attending seminars / workshops, preparations for examinations etc. would be considered as notional hours. The present syllabus considers (60L as class room teaching and 15 lectures as Notional hours/ paper). Each lecture duration would be for 48 min

The names of the reference books provided in the syllabus are for guidance purpose only. Students and faculty are encouraged to explore additional reference books, online lectures, videos, science journals for latest/ additional information.

Examination pattern for:

Theory:

- The question paper for the Term End Exam would be of **100 marks** consisting of 5 Questions (20M each), of which one question would be common for all units in the syllabus.

- The question paper would be set for 150 marks including internal options.

- There shall be no internal exam for any paper.

Practical:

- Would be conducted over a period of 3 days; 50M each paper.

- Each student to perform 2 major and 2 minor practical for Sem V and 2 major and project presentation for Sem VI ,

- Viva would be conducted during the practical during Sem V; Sem VI would have ONLY project presentation

- Journals would be uniform throughout all the centres; matter would be communicated to all the centres by the syllabus committee.

- Distribution of marks for the experiments carried out during the examination:

  Sem V (50M/ paper): Major: 20M; Minor: 10M; Viva: 10M; Journal 10M.
  Sem VI (50M/paper): Major (x2): 40M; Journal: 10M; Project 50M

  The report could be around 25-30 pages with appropriate referencing and formatting.
  Marks distribution for the project would be as follows:
  25M documentation, 15M presentation, 10 M viva and interactions;

- Students would undertake a project for 1-2 months during the last semester for 50 M. The project **should** include **either** of the following:

  1. One/ more major instrumentation OR
  2. One / more major technique/s required in the field of interest OR
  3. Bioinformatics OR
  4. Biostatistics

UNIVERSITY OF MUMBAI

No. UG/76 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular Nos. UG/66 of 2012-13, dated 12th September, 2012 relating to syllabus of the Bachelor of Science (B.Sc.) programme in the course of Information Technology.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Information Technology at its meeting held on 8th June, 2018 have been accepted by the Academic Council at its meeting held on 14th June, 2018 **vide** item No. 4.49 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Information Technology (Sem – V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
6th ~~June~~, 2018
July

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.49/14/06/2018

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No. UG/ 76 -A of 2018 MUMBAI-400 032 6th ~~June~~, 2018
July

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Ad-hoc Board of Studies in Information Technology,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

Project Dissertation Semester V and Project Implementation Semester VI

Chapter 1 to 4 should be submitted in Semester V in spiral binding. These chapter have also to be included in Semester VI report. Semester VI report has to be hard bound with golden embossing. Students will be evaluated based on the dissertation in semester V and dissertation and viva voce in Semester VI.

I. OBJECTIVES

- Describe the Systems Development Life Cycle (SDLC).
- Evaluate systems requirements.
- Complete a problem definition.
- Evaluate a problem definition.
- Determine how to collect information to determine requirements.

- Perform and evaluate feasibility studies like cost-benefit analysis, technical feasibility, time feasibility and Operational feasibility for the project.
- Work on data collection methods for fact finding.
- Construct and evaluate data flow diagrams.
- Construct and evaluate data dictionaries.
- Evaluate methods of process description to include structured English, decision tables and decision trees.
- Evaluate alternative tools for the analysis process.
- Create and evaluate such alternative graphical tools as systems flow charts and state transition diagrams.
- Decide the S/W requirement specifications and H/W requirement specifications.
- Plan the systems design phase of the SDLC.
- Distinguish between logical and physical design requirements.
- Design and evaluate system outputs.
- Design and evaluate systems inputs.
- Design and evaluate validity checks for input data.
- Design and evaluate user interfaces for input.
- Design and evaluate file structures to include the use of indexes.
- Estimate storage requirements.
- Explain the various file update processes based on the standard file organizations.
- Decide various data structures.
- Construct and evaluate entity-relationship (ER) diagrams for RDBMS related projects.
- Perform normalization for the unnormalized tables for RDBMS related projects
- Decide the various processing systems to include distributed, client/server, online and others.
- Perform project cost estimates using various techniques.
- Schedule projects using both GANTT and PERT charts.
- Perform coding for the project.
- Documentation requirements and prepare and evaluate systems documentation.
- Perform various systems testing techniques/strategies to include the phases of testing.
- Systems implementation and its key problems.

- Generate various reports.
- Be able to prepare and evaluate a final report.
- Brief the maintenance procedures and the role of configuration management in operations.
- To decide the future scope and further enhancement of the system.
- Plan for several appendices to be placed in support with the project report documentation.
- Decide the various processing systems to include distributed, client/server, online and others.
- Perform project cost estimates using various techniques.
- Schedule projects using both GANTT and PERT charts.
- Perform coding for the project.
- Documentation requirements and prepare and evaluate systems documentation.
- Perform various systems testing techniques/strategies to include the phases of testing.
- Systems implementation and its key problems.
- Generate various reports.
- Be able to prepare and evaluate a final report.
- Brief the maintenance procedures and the role of configuration management in operations.
- To decide the future scope and further enhancement of the system.
- Plan for several appendices to be placed in support with the project report documentation.
- Work effectively as an individual or as a team member to produce correct, efficient, well-organized and documented programs in a reasonable time.
- Recognize problems that are amenable to computer solutions, and knowledge of the tool necessary for solving such problems.
- Develop of the ability to assess the implications of work performed.
- Get good exposure and command in one or more application areas and on the software
- Develop quality software using the software engineering principles
- Develop of the ability to communicate effectively.

II. Type of the Project

The majority of the students are expected to work on a real-life project preferably in some industry/ Research and Development Laboratories/Educational Institution/Software Company. Students are encouraged to work in the areas listedbelow . However, it is ***not mandatory*** for a

student to work on a real-life project. The student can formulate a project problem with the help of her/his Guide and submit the project proposal of the same. **Approval of the project proposal is mandatory**. If approved, the student can commence working on it, and complete it. Use the latest versions of the software packages for the development of the project.

III. SOFTWARE AND BROAD AREAS OF APPLICATION

FRONT END / GUI Tools	.Net Technologies,Java
DBMS/BACK END	Oracle, SQL Plus, MY SQL, SQL Server,
LANGUAGES	C, C++, Java, VC++, C#, R,Python
SCRIPTING LANGUAGES	PHP,JSP, SHELL Scripts (Unix), TcL/TK,
.NET Platform	F#,C#. Net, Visual C#. Net, ASP.Net
MIDDLE WARE (COMPONENT) TECHNOLOGIES	COM/DCOM, Active-X, EJB
UNIX INTERNALS	Device Drivers, RPC, Threads, Socket programming
NETWORK/WIRELESS TECHNOLOGIES	-
REALTIME OPERATING SYSTEM/ EMBEDDED SKILLS	LINUX, Raspberry Pi, Arduino, 8051
APPLICATION AREAS	Financial / Insurance / Manufacturing / Multimedia / Computer Graphics / Instructional Design/ Database Management System/ Internet / Intranet / Computer Networking-Communication Software development/ E-Commerce/ ERP/ MRP/ TCP-IP programming / Routing protocols programming/ Socket programming.

IV.Introduction

The project report should be documented with scientific approach to the solution of the problem that the students have sought to address. The project report should be prepared in order to solve the problem in a methodical and professional manner, making due references to appropriate techniques, technologies and professional standards. The student should start the documentation process from the first phase of software development so that one can easily identify the issues to be focused upon in the ultimate project report. The student should also include the details from