Syllabus for
FYBSc.
Course – ZOOLOGY
To be implemented from Academic year 2015-16
SEMESTER - I

COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES/WEEK
USZO101	I	Wonders of animal world	2	1
	II	Biodiversity and its conservation		1
	III	Footsteps to follow		1
USZO102	I	Laboratory safety and Units of Measurement	2	1
	II	Animal Biotechnology		1
	III	Instrumentation		1
USZOP1	Practical based on both courses		2	6

SEMESTER - II

COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES/WEEK
USZO201	I	Population Ecology	2	1
	II	Ecosystem		1
	III	National park and Sanctuaries		1
USZO202	I	Nutrition and Health	2	1
	II	Public health and Hygiene		1
	III	Common human Diseases		1
USZOP2	Practical based on both courses		2	6

Syllabus for S. Y. B. Sc. Course: ZOOLOGY
Credit Based Semester and Grading System
(To be implemented from the Academic Year 2018-2019)

SEMESTER – III

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO301	I	Fundamentals of Genetics	2	1
	II	Chromosomes and Heredity		1
	III	Nucleic Acids		1
USZO302	I	Nutrition and Excretion	2	1
	II	Respiration and Circulation		1
	III	Control and Coordination of Life Processes, Locomotion and Reproduction		1
USZOE303A ELECTIVE 1	I	Ethology	2	1
	II	Parasitology		1
	III	Economic Zoology		1
USZOE303B ELECTIVE 2	I	Maintenance of Aquarium	2	1
	II	Agricultural, Household Pests and their Control		1
	III	Amazing Animals		1
USZOP3		Practicals based on all three courses	03	9

Important Note: College may choose either Elective 1 or Elective 2 for Semester III and Semester IV as their third course depending on the preference selected by majority of the students and endorsed by Head of the Department of Zoology and the Principal of the college.

SEMESTER IV

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO401	I	Origin and Evolution of Life	2	1
	II	Population Genetics and Evolution,		1
	III	Scientific Attitude, Methodology, Scientific Writing and Ethics in Scientific Research		1
USZO402	I	Cell Biology	2	1
	II	Endomembrane System		1
	III	Biomolecules		1
USZOE403A ELECTIVE 1	I	Comparative Embryology	2	1
	II	Aspects of Human Reproduction		1
	III	Pollution and its Effect on Organisms		1
USZOE403B ELECTIVE 2	I	Dairy Industry	2	1
	II	Sericulture		1
	III	Aquaculture		1
USZOP4		Practicals based on all three courses	03	9

Important Note: College may choose either Elective 1 or Elective 2 for Semester III and Semester IV as their third course depending on the preference selected by majority of the students and endorsed by Head of the Department of Zoology and the Principal of the college.

Syllabus for T. Y. B. Sc. Course: ZOOLOGY
Credit Based Semester and Grading System
- with a Choice for Additional Credits
(To be implemented from the Academic Year 2018-2019)

SEMESTER - V

THEORY

URSE .	COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES WEEK
11	USZO501	I	Principles of Taxonomy	2.5	1
		II	Kingdom: Animalia I		1
		III	Kingdom: Animalia II		1
		IV	Type study: *Sepia*		1
12	USZO502	I	Basic Haematology	2.5	1
		II	Applied Haematology		1
		III	Basic Immunology		1
		IV	Applied Immunology		1
13	USZO503	I	Mammalian Histology	2.5	1
		II	Toxicology		1
		III	General Pathology		1
		IV	Biostatistics		1
14	USZO504	I	Integumentary system and derivatives	2.5	1
		II	Human Osteology		1
		III	Muscles of long bones of Human limbs		1
		IV	Developmental biology of Chick		1
				10	**16**
RACTICAL					
SZOP05	Practicals based on all four courses			**06**	**16**
otal Number of Credits and Workload				**16**	**32**
esearch Project					
SZOR01	Additional Credits (Choice Based / Optional)			**1**	**No Workloa for Teachers**

Syllabus for T. Y. B. Sc. Course: ZOOLOGY

Credit Based Semester and Grading System - with a Choice for Additional Credits

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

SEMESTER - VI					
THEORY					
COURSE NO.	COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES/ WEEK
15	USZO601	I	Phylum Chordata: Group Protochordata and Group Euchordata I	2.5	1
		II	Group Euchordata II		1
		III	Group Euchordata III		1
		IV	Type study: Shark		1
16	USZO602	I	Enzymology	2.5	1
		II	Homeostasis		1
		III	Endocrinology		1
		IV	Animal Tissue Culture		1
17	USZO603	I	Molecular Biology	2.5	1
		II	Genetic Engineering		1
		III	Human Genetics		1
		IV	Bioinformatics		1
18	USZO604	I	Environment management	2.5	1
		II	Wildlife management		1
		III	Bioprospecting and Zoopharmacognosy		1
		IV	Zoogeography		1
				10	16
PRACTICAL					
USZOP06	Practicals based on all four courses			06	16
Total Number of Credits and Workload				16	32
Research Project					
USZOR02	Additional Credits (Choice Based / Optional)			1	No Workload for Teachers

AC - 11th May, 2017
Item No. 4.282

T. Y. B.Sc.

(Credit Based Semester and Grading System)
Fishery Biology (Applied Component)
(to be implemented from the Academic Year 2017-2018)

Semester V

Oceanography, Aquaculture Practices, Marketing and Finance

Theory (Any four units to be opted)				
Course	**Unit**	**TOPIC**	**Credits**	**L/Week**
USACFBIO501	1	Oceanography	2	4
	2	Crafts and Gear		
	3	Farming of Major Carps		
	4	Introduction to other Commercial Aquaculture Practices in Fresh Water		
	5	Culture of Shell fishes and Fin-Fish		
	6	Quality Control and Packaging		
	7	Marketing and Finance		
	8	Case Study and Simulation		
Practical				
USACFBIO5P1		Practicals based on Course **USACFBIO501**	2	4

Semester VI

Marine resources, Post-harvest and Farm Engineering

Theory (Any four units to be opted)				
Course	**Unit**	**TOPIC**	**Credits**	**L/Week**
USACFBIO601	1	Marine Fin-fish of India	2	4
	2	Marine Shellfish of India		
	3	Nutrition		
	4	Diseases		
	5	Preservation and Processing		
	6	Byproducts and Value added Products		
	7	Farm Engineering		
	8	Open Unit		
Practical				
USACFBIO6P1		Practicals based on Course **USACFBIO601**	2	4

UNIVERSITY OF MUMBAI

No. UG/73of 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/156 of 2016-17, dated 16th November, 2016 relating to syllabus of the Bachelor of Science (B.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. 4.41 and that in accordance therewith, the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem - V & VI) (3 and 6 Units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals 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./4.41/14/06/2018

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No. UG/ 73 -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 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

T.Y.B.Sc. CHEMISTRY (6 UNITS)

SEMESTER V

ANALYTICAL CHEMISTRY

COURSE CODE: USCH504 CREDITS: 02 LECTURES: 60

UNIT I :INTRODUCTION TO QUALITY CONCEPTS,CHEMICAL CALCULATIONS AND SAMPLING (3 & 6 UNITS)			
1.1	**Quality in Analytical Chemistry**		**05 L**
	1.1.1	Concepts of Quality, Quality Control and Quality Assurance	
	1.1.2	Importance of Quality concepts in Industry	
	1.1.3	Chemical Standards and Certified Reference Materials; Importance in chemical analysis Quality of material: Various grades of laboratory reagents	
1.2	**Chemical Calculations (Numericals and word problems are expected)**		**04 L**
	1.2.1	Inter conversion of various concentration units. (Conversion of concentration from one unit to another unit with examples)	
	1.2.2	Percent composition of elements in chemical compounds	
1.3	**Sampling**		**06 L**
	1.3.1	Purpose, significance and difficulties encountered in sampling	
	1.3.2	Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipments and methods of sampling of compact solids, sampling of particulate solids, methods and equipments used for sampling of particulate solids.	
	1.3.3	Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids.	
	1.3.4	Sampling of gases: Ambient and stack sampling: Apparatus and methods for sampling of gases.	

	1.3.5	Collection, preservation and dissolution of the sample.	
UNIT II : CLASSICAL METHODS OF ANALYSIS (TITRIMETRY) (3 & 6 UNITS)			
2.1	**Redox Titrations (Numerical and word Problems are expected)**		**08 L**
	2.1.1	Introduction	
	2.1.2	Construction of the titration curves and calculation of E_{system} in aqueous medium in case of: (1) One electron system (2) Multielectron system	
	2.1.3	Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	
2.2	**Complexometric Titrations**		**07 L**
	2.2.1	Introduction, construction of titration curve	
	2.2.2	Use of EDTA as titrant and its standardisation, absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity with examples. Advantages and limitations of EDTA as a titrant.	
	2.2.3	Types of EDTA titrations.	
	2.2.4	Metallochromic indicators, theory, examples and applications	
UNIT III: OPTICAL METHODS(6 UNITS)			
3.1	**Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS)**		**07 L**
	3.1.1	Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra	
	3.1.2	Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors)	
	3.1.3	Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser)	
	3.1.4	Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method.	
	3.1.5	Comparison between FES and AAS	

	3.1.6	Applications, Advantages and Limitations	
3.2	**Molecular Fluorescence and Phosphorescence Spectroscopy**		**04L**
	3.2.1	Introduction and Principle	
	3.2.2	Relationship of Fluorescence intensity with concentration	
	3.2.3	Factors affecting Fluorescence and Phosphorescence	
	3.2.4	Instrumentation and applications	
	3.2.5	Comparison of Fluorimetry and Phosphorimetry	
	3.2.6	Comparison with Absorption methods	
3.3	**Turbidimetry and Nephelometry**		**04 L**
	3.3.1	Introduction and Principle	
	3.3.2	Factors affecting scattering of Radiation: Concentration, particle size, wavelength, refractive index	
	3.3.3	Instrumentation and Applications	
UNIT IV: METHODS OF SEPARATION – I (6 UNITS)			
4.1	**Solvent Extraction**		**06 L**
	4.1.1	Factors affecting extraction: Chelation, Ion pair formation and Solvation	
	4.1.2	Graph of percent extraction versus pH. Concept of $[pH]_{1/2}$ and its significance (derivation not expected)	
	4.1.3	Craig's counter current extraction: Principle, apparatus and applications	
	4.1.4	Solid phase extraction: Principle, process and applications with special reference to water and industrial effluent analysis.	
	4.1.5	Comparison of solid phase extraction and solvent extraction.	
4.2	**High Performance Liquid chromatography (HPLC)**		**06L**
	4.2.1	Introduction and Principle Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating pumps, screw driven- syringe type pumps, pneumatic pumps, advantages and disadvantages of each pump), Precolumn, Sample injection system, HPLC Columns, Detectors(UV – Visible detector, Refractive index detector)	
	4.2.2	Qualitative and Quantitative Applications of HPLC	

4.3	**High Performance Thin Layer Chromatography (HPTLC)**		**03 L**
	4.3.1	Introduction and Principle Stationary phase, Sample application and mobile phase	
	4.3.2	Detectors a) Scanning densitometer- Components. Types of densitometer- Single beam and Double beam b) Fluorometric Detector	
	4.3.3	Advantages, disadvantages and applications	
	4.3.4	Comparison of TLC and HPTLC	

REFERENCES

1.	3000 solved problems in Chemistry, David E. Goldberg,PhD.,Schaums Outline	Unit/s: (1.2)
2.	A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002),	Unit/s (1.1)
3.	A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001)	Unit/s (1.3)
4.	Analytical Chemistry, Gary.D Christan, 5th edition	Unit/s (4.1,4.2,4.3)
5.	Analytical Chemistry Skoog, West ,Holler,7th Edition:	Unit/s (2.1)
6.	Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication	Unit/s (4.1,4.2,4.3)
7.	Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited	Unit/s (4.1,4.2,4.3)
8.	Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969	Unit/s (4.1,4.2,4.3)
9.	Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition	Unit/s (4.1,4.2,4.3)
10.	Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990	Unit/s (1.1)
11.	High Performance Thin Layer Chromatography by Dr P.D. Sethi, CBS Publisher and Distribution	Unit/s(4.1,4.2,4.3)
12.	High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer	Unit/s (4.1,4.2,4.3)
13.	Instrumental methods of Analysis, by Dr Supriya S	Unit/s (4.1,4.2,4.3)

	Mahajan, Popular Prakashan Ltd	
14.	Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd	Unit/s (3.1,3.2,3.3)
15.	Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House	Unit/s (4.1,4.2,4.3)
16.	Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman	Unit/s (4.1,4.2,4.3)(3.1,3.2,3.3)
17.	Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press (2018)	Unit/s (1.1)
18.	Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995	Unit/s (1.1)
19.	Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969	Unit/s (4.1,4.2,4.3)
20.	Thin Layer Chromatography, A LAB. Handbook, Egon Stahl, Springer International Student Edition	Unit/s (4.1,4.2,4.3)

PRACTICALS

SEMESTER V

ANALYTICAL CHEMISTRY

COURSE CODE: USCHP13 **CREDITS: 02**

1. Spectrophotometric estimation of fluoride
2. Estimation of magnesium content in Talcum powder by complexometry, using standardized solution of EDTA
3. Determination of COD of water sample.
4. To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve method).
5. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.
6. To determine the amount of sulphate in given water sample turbidimetrically.

Note: Calculation of percent error is expected for all the experiments.

REFERENCES

1.	Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2.	Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al

SEMESTER VI

ANALYTICAL CHEMISTRY

COURSE CODE: USCH604 CREDITS: 02 LECTURES: 60

UNIT I: ELECTRO ANALYTICAL TECHNIQUES(3 & 6 UNITS)			
1.1	**Polarography (Numerical and word problems are expected)**		**11L**
	1.1.1	Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes	
	1.1.2	Basic principle of polarography H shaped polarographic cell, DME (construction, working, advantages and limitations)	
	1.1.3	DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors Qualitative aspects of Polarography: Half wave potential $E_{1/2}$, Factors affecting $E_{1/2}$ Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation)	
	1.1.4	Quantification 1) Wave height – Concentration plots (working plots/calibration) 2) Internal standard (pilot ion) method 3) Standard addition method	
	1.1.5	Applications advantages and limitations	
1.2	**Amperometric Titrations**		**04L**
	1.2.1	Principle, Rotating Platinum Electrode(Construction, advantages and limitations)	
	1.2.2	Titration curves with example	
	1.2.3	Advantages and limitations	
UNIT II: METHODS OF SEPARATION - II (3 & 6 UNITS)			
2.1	**Gas Chromatography (Numerical and word problems are expected)**		**09 L**

	2.1.1	Introduction, Principle, Theory and terms involved	
	2.1.2	Instrumentation: Block diagram and components,types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD	
	2.1.3	Qualitative, Quantitative analysis and applications	
	2.1.4	Comparison between GSC and GLC	
2.2	**Ion Exchange Chromatography**		**06 L**
	2.2.1	Introduction, Principle.	
	2.2.2	Types of Ion Exchangers , Ideal properties of resin	
	2.2.3	Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor Factors affecting separation of ions	
	2.2.4	Ion exchange capacity and its determination for cation and anion exchangers.	
	2.2.5	Applications of Ion Exchange Chromatography with reference to Preparation of demineralised water, Separation of amino acids	
UNIT III:FOOD AND COSMETICS ANALYSIS(6 UNITS)			
3.1	**Introduction to food chemistry**		**10 L**
	3.1.1	Food processing and preservation: Introduction, need, chemical methods, action of chemicals(sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control Physical methods (Pasteurization and Irradiation)	
	3.1.2	Determination of boric acid by titrimetry and sodium benzoate by HPLC.	
	3.1.3	Study and analysis of food products and detection of adulterants **1)** Milk: Composition & nutrients, types of milk (fat free, organic and lactose milk) Analysis of milk for lactose by Lane Eynon's Method **2)** Honey: Composition	

		Analysis of reducing sugars in honey by Coles Ferricyanide method **3)** Tea: Composition, types (green tea and mixed tea) Analysis of Tannin by Lowenthal's method **4)** Coffee: Constituents and composition, Role of Chicory Analysis of caffeine by Bailey Andrew method	
3.2	**Cosmetics**		**05 L**
	3.2.1	Introduction and sensory properties	
	3.2.2	Study of cosmetic products – **1)** Face powder: Composition Estimation of calcium and magnesium by complexometric titration **2)** Lipstick: Constituents Ash analysis for water soluble salts: borates, carbonates and zinc oxide **3)** Deodorants and Antiperspirants: Constituents, properties Estimation of zinc by gravimetry	
UNIT IV:THERMAL METHODS AND ANALYTICAL METHOD VALIDATION (6 UNITS)			
4.1	**Thermal Methods**		**12 L**
	4.1.1	Introduction to various thermal methods (TGA, DTA and Thermometric titration)	
	4.1.2	**Thermogravimetric Analysis(TGA)** Instrumentation-block diagram,thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder) Thermogram (TG curve)for$CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$ Factors affecting thermogram-Instrumental factors and Sample characteristics Applications: Determination of drying and ignition temperature range Determination of percent composition of binary mixtures	

		(Estimation of Calcium and Magnesium oxalate)	
	4.1.3	**Differential Thermal Analysis (DTA):** Principle**,** Instrumentation, and Reference material used	
		Differential thermogram (DTA curve) $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$	
		Applications Comparison between TGA and DTA.	
	4.1.4	**Thermometric Titrations –** Principle and Instrumentation Thermometric titrations of : 1) HCl v/s NaOH 2) Boric acid v/s NaOH 3) Mixture of Ca^{+2} and Mg^{+2} v/s EDTA 4) Zn^{+2} with Disodium Tartarate**.**	
4.2	**Analytical Method Validation**		**03L**
	4.2.1	Introduction and need for validation of a method	
	4.2.2	Validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness	

Note: Concept of sensitivity is to be discussed for all techniques and instruments mentioned in the syllabus.

REFERENCES

1.	An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer	Unit/s (3.1,3.2)
2.	Analysis of food and Beverages, George Charalanbous, Academic press 1978	Unit/s (3.1,3.2)
3.	Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge	Unit/s (4.1,4.2)
4.	Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc.	Unit/s (4.1,4.2)
5.	Analytical Chemistry, Gary.D Christan, 5th edition	Unit/s (2.1,2.2)
6.	Analytical chemistry, R. K. Dave.	Unit/s (2.1,2.2)

7.	Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969	Unit/s (2.1,2.2)
8.	Egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8	Unit/s (1.1,1.2,1.3)
9.	Food Analysis, Edited by S. Suzanne Nielsen, Springer	Unit/s (3.1,3.2)
10.	Food Analysis: Theory and practice, YeshajahuPomeranz, Clifton E. Meloan, Springer	Unit/s (3.1,3.2)
11.	Formulation and Function of cosmetics, Sa Jellineck	Unit/s (3.1,3.2)
12.	Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition (1992)	Unit/s (2.1,2.2)
13.	Government of India publications of food drug cosmetic act and rules.	Unit/s (3.1,3.2)
14.	Harry's Cosmetology, Longman scientific co.	Unit/s (3.1,3.2)
15.	High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer	Unit/s (3.1,3.2)
16.	Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd	Unit/s (1.1,1.2,1.3) (4.1,4.2,4.3)
17.	Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006.	Unit/s (1.1,1.2,1.3)
18.	Modern cosmetics, E. Thomessen Wiley Inter science	Unit/s (3.1,3.2)
19.	Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman	Unit/s (4.1,4.2,4.3)
20.	Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook ISBN: 978148326478	Unit/s (1.1,1.2,1.3)
21.	Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969	Unit/s (2.1,2.2,)

PRACTICALS

SEMESTER VI

ANALYTICAL CHEMISTRY

COURSE CODE: USCHP14 **CREDITS: 02**

1 Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide.

2 Estimation of reducing sugar in honey by Willstatter method.

3 Estimation o Mg^{+2} & Zn^{+2} by anion exchange resin.
using an anion exchange resin

4 Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.

5 Determination of phosphoric acid in cola sample pH metrically.

Note: Calculation of percent error is expected for all the experiments.

References:

1.	Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2.	Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al
3.	The chemical analysis of food and food products III edition Morris Jacob
4.	The chemical analysis of food by David Pearson and Henry Edward

UNIVERSITY OF MUMBAI

No. UG/73of 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/156 of 2016-17, dated 16th November, 2016 relating to syllabus of the Bachelor of Science (B.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. 4.41 and that in accordance therewith, the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem - V & VI) (3 and 6 Units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals 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./4.41/14/06/2018

****

No. UG/ 73 -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 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

T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Semester and Grading System

SEMESTER V

INORGANIC CHEMISTRY

COURSE CODE: USCH502 **CREDITS: 02** **LECTURES: 60**

UNIT-I	**L/Week**
1. Molecular Symmetry and Chemical Bonding	
1.1Molecular Symmetry (6L)	
1.1.1 Introduction and Importance of Symmetry in Chemistry.	
1.1.2 Symmetry elements and Symmetry operations.	
1.1.3 Concept of a Point Group with illustrations using the following point groups :(i)$C_{\infty V}$ (ii) $D_{\infty h}$ (iii) C_{2V} (iv) C_{3v} (v)C_{2h} and (vi)D_{3h}	
1.2 Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species (9L)	
1.2.1 Comparision between homonuclear and heteronuclear diatomic molecules.	
1.2.2. Heteronuclear diatomic molecules like CO, NO and HCl, appreciation of modified MO diagram for CO.	
1.2.3 Molecular orbital theory for H_3 and H_3^+ (correlation diagram expected).	
1.2.4. Molecular shape to molecular orbital approach in AB_2 molecules. Application of symmetry concepts for linear and angular species considering σ- bonding only. (Examples like : i) BeH_2, ii) H_2O).	
UNIT-II	
2 SOLID STATE CHEMISTRY	
2.1 Structures of Solids (11L)	
2.2.1 Explanation of terms viz.crystal lattice, lattice point, unit cell and lattice constants.	
2.1.2 Closest packing of rigid spheres (hcp,ccp), packing density in simple cubic, bcc and fcc lattices. Relationship between density, radius of unit cell and lattice parameters.	

2.1.3 Stoichiometric Point defects in solids (discussion on Frenkel and Schottky defects expected).	
2.2 Superconductivity (4L)	
2.2.1 Discovery of superconductivity.	
2.2.2 Explanation of terms like superconductivity, transition temperature, Meissner effect.	
2.2.3 Different types of super conductors viz.conventional superconductors, alkali metal fullerides, high temperature super conductors.	
2.2.4 Brief application of superconductors.	
UNIT-III	
3.0 CHEMISTRY OF INNER TRANSITION ELEMENTS (15L)	
3.1 Introduction: Position in periodic table and electronic configuration of lanthanides and actinides.	
3.2 Chemistry of Lanthanides with reference to (i) lanthanide contraction and its consequences(ii) Oxidation states (iii) Ability to form complexes (iv) Magnetic and spectral properties	
3.3 : Occurrence, extraction and separation of lanthanides by (i) Ion Exchange method and (ii) Solvent extraction method (Principles and technique)	
3.4 Applications of lanthanides	
UNIT-IV	
4. SOME SELECTED TOPICS	
4.1 Chemistry of Non-aqueous Solvents (5 L)	
4.1.1Classification of solvents and importance of non-aqueous solvents.	
4.1.2 Characteristics and study of liquid ammonia, dinitrogen tetra oxide as non-aqueous solvents with respect to : (i) acid-base reactions and (ii) redox reactions.	
4.2 Comparative Chemistry of Group 16 (5L)	
4.2.1 Electronic configurations, trends in physical properties, allotropy	
4.2.2 Manufacture of sulphuric acid by Contact process.	
4.3 Comparative Chemistry of Group 17 (5L)	
4.3.1Electronic configuration , General characteristics, anamolous properties of fluorine, comparative study of acidity of oxyacids of chlorine w.r.t acidity, oxidising properties and structures(on the basis of VSEPR theory)	
4.3.2 Chemistry of interhalogens with reference to preparations, properties and structures (on the basis of VSEPR theory) .	

REFERENCES

SEM-V

Unit-I

1. Per Jensen and Philip R. Bunker , Fundamentals of Molecular Symmetry , Series in Chemical Physics, Taylor & Francis Group
2. J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press
3. Derek W. Smith, Molecular orbital theory in inorganic chemistry Publisher: Cambridge University Press
4. C. J. Ballhausen, Carl Johan Ballhausen, Harry B. Gray Molecular Orbital Theory: An Introductory Lecture Note and Reprint Volume Frontiers in chemistry Publisher W.A. Benjamin, 1965
5. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
6. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd

Unit-II

1. Lesley E. Smart, Elaine A. Moore Solid State Chemistry: An Introduction, 2nd Edition CRC Press,
2. C. N. R. Rao Advances in Solid State Chemistry
3. R.G. Sharma Superconductivity: Basics and Applications to Magnets
4. Michael Tinkham ,Introduction to Superconductivity: Vol I (Dover Books on Physics)
5. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
6. Richard Harwood, Chemistry, Cambridge University Press,
7. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd .

Unit-III

1. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
2. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
3. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
4. G. Singh, Chemistry of Lanthanides and Actinides, Discovery Publishing House
5. Simon Cotton , Lanthanide and Actinide Chemistry Publisher: Wiley-Blackwell

Unit-IV

1. B. H. Mahan, University Chemistry, Narosa publishing.
2. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.

3. J. D. Lee, Concise Inorganic Chemistry, 4thEdn., ELBS,
4. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
5. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
6. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt,.Ltd. (2002).
7. Richard Harwood, Chemistry, chapter 10 Industrial inorganic chemistry
8. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
9. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993
10. Satya Prakash, G.D.Tuli, R.D. Madan , Advanced Inorganic Chemistry.S. Chand & Co Ltd 2004

Practicals

SEMESTER V

INORGANIC CHEMISTRY

COURSE CODE: USCHP05 **CREDITS: 02**

Course USCH502: Inorganic Practicals (60L)

I. Inorganic preparations

1. Preparation of Potassium diaquobis- (oxalato)cuprate (II)
2. Preparation of Ferrous ethylene diammonium sulphate.
3. Preparation of bisacetylacetonatocopper(II)

II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests).

(Any three salts of transition metal ions)

Reference Books (practicals)

1. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.

2. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
3. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition.

SEMESTER VI

INORGANIC CHEMISTRY

COURSE CODE: USCH602 CREDITS: 02 LECTURES: 60

COURSE CODE	**CREDITS**	
USCH602	**(60 Lectures)**	
(Numericals and word problems are expected)		
UNIT-I		**L/week**
1.Theories of the metal-ligand bond (I) (15L)		
1.1 Limitations of Valence Bond Theory.		
1.2 Crystal Field Theory and effect of crystal field on central metal valence orbitals in various geometries from linear to octahedral(from coordination number 2 to coordination number 6)		
1.3 Splitting of *d* orbitals in octahedral, square planar and tetrahedral crystal fields.		
1.4 Distortions from the octahedral geometry : (i) effect of ligand field and (ii) Jahn-Teller distortions.		
1.5 Crystal field splitting parameters Δ ; its calculation and factors affecting it in octahedral complexes, Spectrochemical series.		
1.6 Crystal field stabilization energy(CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations.		
1.7 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series.		
1.8 Limitations of CFT : Evidences for covalence in metal complexes (i) intensities of d-d transitions, (ii) ESR spectrum of $[IrCl_6]^{2-}$ (iii) Nephelauxetic effect.		
UNIT-II		
2.Theories of the metal-ligand bond (II)		
2.1 Molecular orbital Theory for coordination compounds. (4L)		

2.1.1 Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals.	
2.1.2 Construction of ligand group orbitals.	
2.1.3 Construction of σ-molecular orbitals for an ML_6 complex.	
2.1.4 Effect of π-bonding on complexes .	
2.1.5 Examples like $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$, $[FeF_6]^{-3}$, $[Fe(CN)_6]^{-3}$, $[CoF_6]^{-3}$, $[Co(NH_3)_6]^{+3}$	
2.2 Stability of Metal-Complexes (4L)	
2.2.1 Thermodynamic and kinetic perspectives of metal complexes with examples.	
2.2.2 Stability constants: stepwise and overall stability constants and their interrelationship.	
2.2.3 Factors affecting thermodynamic stability.	
2.3 Reactivity of metal complexes. (4L)	
2.3.1 Comparison between Inorganic and organic reactions.	
2.3.2 Types of reactions in metal complexes.	
2.3.3 Inert and labile complexes : correlation between electronic configurations and lability of complexes.	
2.3.4 Ligand substitution reactions : Associative and Dissociative mechanisms.	
2.2.5 Acid hydrolysis, base hydrolysis and anation reactions.	
2.4 Electronic Spectra. (3L)	
2.4.1Origin of electronic spectra	
2.4.2 Types of electronic transitions in coordination compounds: intra- ligand,Charge transfer and intra-metal transitions.	
2.4.3 Selection rules for electronic transitions.	
2.4.4 Electronic configuration and electronic micro states, Terms and Term symbols for transition metal ions, rules for determination of ground state term.	
2.4.5 Determination of Terms for p^2 and d^1 electronic configurations.	
UNIT-III	
3 ORGANOMETALLIC CHEMISTRY (15L)	
3.1 Organometallic Compounds of main group metal (6L)	
3.1.1General characteristics of various types of organometallic compounds, viz.ionic, σ-bonded and electron deficient compounds.	
3.1.2 General synthetic methods of organometallic compounds : (i) Oxidative-addition, (ii)Metal-metal exchange(transmetallation), (iii) Carbanion-halide exchange, (iv) Metal-hydrogen exchange(metallation) and (v) Methylene-insertion reactions.	
3.1.3 Some chemical reactions of organometallic compounds:	

(i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents, (iv) Redistribution reactions and (v) Complex formation reactions.	
3.2 Metallocenes (5L)	
Introduction, Ferrocene : Synthesis, properties, structure and bonding on the basis of VBT.	
3.3 Catalysis (4L)	
3.3.1 Comparison between homogeneous and heterogeneous catalysis	
3.3.2 Basic steps involved in homogeneous catalysis	
3.3.3 Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.	
UNIT-IV	
4 SOME SELECTED TOPICS (15L)	
4.1 Metallurgy (7L)	
4.1.1 Types of metallurgies,	
4.1.2 General steps of metallurgy; Concentration of ore, calcinations, roasting,reduction and refining.	
4.1.3 Metallurgy of copper: occurrence, physicochemical principles, Extraction of copper from pyrites& refining by electrolysis.	
4.2 Chemistry of Group 18 (5L)	
4.2.1 Historical perspectives	
4.2.2 General characteristics and trends in physical and chemical properties	
4.2.3 Isolation of noble gases	
4.2.4 Compounds of Xenon (oxides and fluorides) with respect to preparation and structure (VSEPR)	
4.2.5 Uses of noble gases	
4.3 Introduction to Bioinorganic Chemistry. (3L)	
4.3.1Essential and non essential elements in biological systems.	
4.3.2 Biological importance of metal ions such as Na^{+},K^{+},Fe^{+2}/Fe^{+3} and Cu^{+2}(Role of Na^{+} and K^{+} w.r.t ion pump)	

References.

SEM-VI

Unit-I:

1. Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House
3. R. Gopalan , V. Ramalingam Concise Coordination Chemistry , Vikas Publishing House;
4. Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House
5. Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole

Unit-II:

1. Ramesh Kapoor and R.S. Chopra, **Inorganic Chemistry**, R. Chand publishers,
2. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY,
3. Twigg ,Mechanisms of Inorganic and Organometallic Reactions Publisher: Springer
4 R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House
5 M. L. Tobe Inorganic Reaction Mechanisms Publisher Nelson, 1972

Unit-III:

1 Cotton, Wilkinson, Murillo and Bochmann, Advanced **Inorganic Chemistry**, 6th Edition..
2 H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005
3 Purecell, K.F. and Kotz, J.C., Inorganic Chemistry W.B. Saunders Co. 1977.
4 Robert H. Crabtree ,The Organometallic Chemistry of the Transition Metals, Publication by John Wiley & Sons
5 B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press
6 Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International.

Unit-IV

1 R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
2 D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
3 Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
4 Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
5 R.Gopalan, Chemistry for undergraduates. Chapter 18. Principles of Metallurgy.(567-591)
6 Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)

7 Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
8 Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
9 Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
10 Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd

PRACTICALS

SEMESTER VI

INORGANIC CHEMISTRY

COURSE CODE: USCHP06 **CREDITS: 02**

I. Inorganic preparations

1. Preparation of Tris(acetylacetonato) iron(III)
2. Green synthesis of bis(dimethylglyoximato) nickel(II) complex using nickel carbonate and sodium salt of dmg .
3. Preparation of potassium trioxalato aluminate (III)

II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests).

(Any three salts of main group metal ions)

Reference Books (practicals)

4. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
5. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
6. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition.

UNIVERSITY OF MUMBAI

No. UG/73of 2018-19

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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. 4.41 and that in accordance therewith, the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem - V & VI) (3 and 6 Units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals 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./4.41/14/06/2018

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No. UG/ 73 -A of 2018 MUMBAI-400 032 6th ~~June~~ July, 2018

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5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

T.Y.B.Sc, CHEMISTRY (Six Units)

SEMESTER V

ORGANIC CHEMISTRY

COURSE CODE: USCH503 **CREDITS: 02** **LECTURES: 60**

Unit I

1.1 Mechanism of organic reactions (10 L)

1.1.1 The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity.

1.1.2 Neighbouring group participation in nucleophilic substitution reactions**:** participation of lone pair of electrons, kinetics and stereochemical outcome.

1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids ($A_{AC}2$) and base promoted hydrolysis of esters ($B_{AC}2$).

1.1.4 Pericyclic reactions, classification and nomenclature

1.1.4.1 Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type)

1.1.4.2 Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates

References:

1. A guidebook to mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson education, New Delhi
2. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
3. Organic reactions & their mechanisms,3rd revised edition, P.S. Kalsi, New Age International Publishers.
4. M.B.Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.

1.2 Photochemistry (5 L)

1.2.1 Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization.

1.2.2 Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4-dienes (di- π methane)

1.2.3 Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol)

References:

1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
2. Organic chemistry,8th edition, John Mc Murry

Unit II

2.1 Stereochemistry I (5 L)

2.1.1 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, roation -reflection (alternating) axis.

2.1.2 Chirality of compounds without a stereo genic center: cummulenes and biphenyls.

References:

1. L. Eliel , stereochemistry of carbon compounds, Tata McGraw Hill
2. Stereochemistry P.S.Kalsi , New Age International Ltd.,4th Edition
3. Stereochemistry by Nassipuri.

2.2 Agrochemicals (4 L)

2.2.1 General introduction & scope, meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators.

2.2.2 Advantages & disadvantages of agrochemicals

2.2.3 Synthesis & application of IAA (Indole Acetic Acid) & Endosulphan,

2.2.4 Bio pesticides – Neem oil & Karanj oil.

References:

1. Insecticides & pesticides: Saxena A. B., Anmol publication.
2. Growth regulators in Agriculture & Horticulture: Amarjit Basra, CRC press 2000.
3. Agrochemicals and pesticides: A.Jadhav and T.V.Sathe.

2.3 Heterocyclic chemistry: (6 L)

2.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quionoline.

2.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler-Napieralski synthesis).

2.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $NaNH_2$/liq.NH_3, n-BuLi.

2.3.4 Reactions of quinoline and isoquinoline; oxidation,reduction,nitration,halogenation and reaction with $NaNH_2$/liq.NH_3,n-BuLi.

References

1. Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.
2. Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
3. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010.
4. Heterocyclic chemistry, 3rd Edition, Thomas L. Gilchrist, Pearson Education, 2007.

Unit III

3.1 IUPAC (5 L)

IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups):

3.1.1 Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds.

3.1.2 Biphenyls

3.1.3 Cummulenes with upto 3 double bonds

3.1.4 Quinolines and isoquinolines

References

1. Nomenclature of Organic Chemistry**:** IUPAC recommendations and preferred Names 2013, RSC publication.
2. IUPAC nomenclature by S.C.Pal.

3.2 Synthesis of organic compounds (10L)

3.2.1 Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, concept of chemo selectivity and regioselectivity with examples, calculation of yields.

3.2.2 Multicomponent Synthesis: Mannich reaction and Biginelli reaction. Synthesis with examples (no mechanism)

3.2.3 Green chemistry and synthesis:

Introduction: Twelve principles of green chemistry, concept of atom economy and E-factor, calculations and their significance, numerical examples.

i) Green reagents: dimethyl carbonate.
ii) Green starting materials : D-glucose
iii) Green solvents : supercritical CO_2
iv) Green catalysts: Bio catalysts.

3.2.4 Planning of organic synthesis

i) synthesis of nitroanilines. (*o&p*)
ii) synthesis of halobenzoic acid.(*o&p*)
iii) Alcohols (primary / secondary / tertiary) using Grignard reagents.
iv) Alkanes (using organo lithium compounds)

Reference:

1. Green chemistry an introductory text : Mike Lancaster.
2. Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
3. Green chemistry an introductory text : RSC publishing.
4. New trends in green chemistry V. K. Ahluwalia , M. Kidwai, Klumer Academic publisher
5. Green chemistry by V. Kumar.
6. Organic chemistry: Francis Carey
7. Organic chemistry: Carey and Sundberg.

Unit IV

4.1 Spectroscopy I (5 L)

4.1.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency

4.1.2 UV – Visible spectroscopy: Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interactions.

4.1.3 Mass spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds.

References:

1. Organic spectroscopy (Second edition),Jag Mohan ,Narosa publication
2. Spectroscopy, Pavia, Lampman, Kriz,Vyvyan.

3. Elementary organic spectroscopy (Third edition), Y.R.Sharma, S.Chand publication..
4. Introduction to spectroscopy (third edition), Pavia ,Lampman,Kriz,john vondeling,Emily Barrosse.
5. Organic chemistry Paula Y. Bruice, Pearson education.
6. Spectral identification of organic molecules by Silverstein.
7. Absorption spectroscopy of organic molecules by V.M.Parikh.

4.2 Natural Products: (10L)

4.2.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule.

4.2.2 Citral:

a) Structural determination of citral.
b) Synthesis of citral from methyl heptenone
c) Isomerism in citral. (cis and trans form).

4.2.3. Alkaloids Introduction and occurrence.

Hofmann's exhaustive methylation and degradation in**:** simple open chain and N – substituted monocyclic amines.

4.2.4 Nicotine:

a) Structural determination of nicotine. (Pinner's work included)
b) Synthesis of nicotine from nicotinic acid
c) Harmful effects of nicotine.

4.2.5 Hormones:

Introduction, structure of adrenaline (epinephrine), physiological action of adrenaline.
Synthesis of adrenaline from

a) Catechol
b) p-hydroxybenzaldehyde(Ott's synthesis)

References:

1. Chemistry of natural products by Chatwal Anand – Vol I and Vol II
2. Chemistry of natural products by O.P. Agarwal
3. Chemistry of natural products by Meenakshi Sivakumar and Sujata Bhat.
4. Organic chemistry by Morrision and Boyd,7th edition.
5. I.L.Finar,Vol-I and Vol-II, 5th edition.

PRACTICALS

SEMESTER V

ORGANIC CHEMISTRY

COURSE CODE: USCHP09 **CREDITS: 02**

A) SEMESTER V: Separation of Binary solid-solid mixture (2.0 gms mixture to be given).

1. Minimum Six mixtures to be completed by the students.
2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols(2-naphthol, 1-naphthol), water insoluble bases

(nitroanilines) , water soluble neutral (thiourea) and water insoluble neutral compounds (anilides , amides, m-DNB, hydrocarbons)

After correct determination of chemical type, the separating reagent should be decided by the student for separation.

4. Follow separation scheme with the bulk sample of binary mixture.

5. After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with m.p..

References:

1. Practical organic chemistry – A. I. Vogel
2. Practical organic chemistry – H.Middleton.
3. Practical organic chemistry – O.P.Aggarwal.

SEMESTER VI

ORGANIC CHEMISTRY

COURSE CODE: USCH603 **CREDITS: 02** **LECTURES: 60**

Unit I

1.1 Stereochemistry II (10 L)

1.1.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and diastereoselectivity (de) , Topicity : enantiotopic and diasterotopic atoms, groups and faces.

1.1.2 Stereochemistry of –

i) Substitution reactions : S_{Ni} (reaction of alcohol with thionyl chloride)

ii) Elimination reactions: E_2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane.

iii) Addition reactions to olefins:

a) bromination (electrophilic anti addition)

b) syn hydroxylation with O_sO_4 and $KMnO_4$

c) epoxidation followed by hydrolysis.

References:

Refer Stereochemistry –I (Sem-V, Unit-II)

1.2 Amino acids & Proteins (5 L)

1.2.1 α-Amino acids: General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel phthalamide synthesis.

1.2.2 Polypeptides and Proteins: nature of peptide bond. Nomenclature and representation of polypeptides (di-and tri-peptides) with examples Merrifield solid phase polypeptide synthesis. .Protiens:general idea of primary,secondary,tertiary & quaternary structure

References:

1. Biochemistry, 8th Ed., Jeremy Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto Pub. W. H. Freeman Publishers
2. Lehninger Principles of Biochemistry 7th Ed., David Nelson and Michael Cox, Publisher W. H. Freeman
3. Name Reactions – Jie Jack Li, 4th Edition, Springer Pub.

Unit II

2.1 Molecular Rearrangements (5 L)

Mechanism of the following rearrangements with examples and stereochemistry wherever applicable.

2.1.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement.

2.1.2 Migration to the electron deficient nitrogen: Beckmann rearrangement.

2.1.3 Migration involving a carbanion : Favorski rearrangement.

2.1.4 Name reactions: Michael addition, Wittig reaction.

References:

Refer Mechanism of organic reaction (Sem-V, Unit-I)

2.2 Carbohydrates (10 L)

2.2.1 Introduction: classification, reducing and non-reducing sugars, DL notation

2.2.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses)
Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons. Chair conformation with stereochemistry of D-glucose, Stability of chair form of D-glucose

2.2.3 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers.

2.2.4 Mutarotation in D-glucose with mechanism

2.2.5 Chain lengthening & shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose)

2.2.6 Reactions of D-glucose and D-fructose:
(a) Osazone formation (b) reduction: Hi/Ni, $NaBH_4$ (c) oxidation: bromine water, HNO_3, HIO_4 (d) acetylation (e) methylation:(d) and (e) with cyclic pyranose forms

2.2.7 Glycosides: general structure

References:

1. Organic chemistry (fourth edition),G,Marc Loudon,Oxford University press.
2. Introduction to Organic Chemistry (Third edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmilan publishing.
3. Organic chemistry fourth edition, Morrision and Boyd.
4. Introduction to Organic chemistry,John McMurry.
5. Organic chemistry volume-1&2 (fifth and sixth edition) IL Finar.

Unit III

3.1 Spectroscopy II (10 L)

3.1.1 IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region.

3.1.2 PMR Spectroscopy: Basic theory of PMR, nature of PMR spectrum, chemical shift (δ unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin- spin coupling and

coupling constant. application of deuterium exchange technique. application of PMR in structure determination.

3.1.3 Spectral characteristics of following classes of organic compounds, including benzene and monosubstituted benzenes, with respect to IR and PMR: (1) alkanes (2) alkenes (3) alkynes (4) haloalkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected).

Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass and NMR spectroscopic technique are expected. (Index of hydrogen deficiency should be the first step in solving the problems).

References:

Refer spectroscopy –I, (Sem-V, Unit-IV)

3.2 Nucleic Acids **(5 L)**

Controlled hydrolysis of nucleic acids. sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structures of nucleic acids (DNA and RNA) including base pairing.

References:

1. Organic chemistry R.T.Morrison and R.N.Boyd, 6th edition, pearson education
2. S.H.Pine, organic chemistry 4th edition. McGraw Hill

Unit IV

4.1 Polymer **(8 L)**

4.1.1 Introduction: terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosets.

4.1.2 Addition polymers: polyethylene, polypropylene, teflon, polystyrene, PVC, Uses.

4.1.3 Condensation polymers: polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins.Uses

4.1.4 Stereochemistry of polymers: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts.

4.1.5 Natural and synthetic rubbers: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer.

4.1.6 Additives to polymers: Plasticisers, stabilizers and fillers.

4.1.7 Biodegradable polymers: Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes.

(Note : Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected)

References:

1. Polymer chemistry by M.G.Arora, K.Singh.
2. Polymer science – a text book by Ahluwalia and Mishra
3. Introduction to polymer chemistry - R.Seymour, Wiley Interscience.

4.2 Catalysts and Reagents **(7 L)**

Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism).

4.2.1 Catalysts: Catalysts for hydrogenation:

a. Raney Nickel

b. Pt and PtO_2 (C=C, CN, NO_2, aromatic ring)
c. Pd/C : C=C, COCl→CHO (Rosenmund)
d. Lindlar catalyst: alkynes

d.2.2 Reagents**:**

a. $LiAlH_4$ (reduction of CO, COOR, CN,NO_2)
b. $NaBH_4$ (reduction of CO)
c. SeO_2 (Oxidation of CH_2 alpha to CO)
d. mCPBA (epoxidation of C=C)
e. NBS (allylic and benzylic bromination)

References:

1. Organic chemistry by Francis Carey – McGrawHill .
2. Oranic chemistry by Carey and Sundberg, Part A & B

PRACTICALS

SEMESTER VI

ORGANIC CHEMISTRY

COURSE CODE: USCHP10 **CREDITS: 02**

A) SEMESTER VI: Separation of Binary liquid-liquid and liquid- solid mixture.

1. Minimum Six mixtures to be completed by the students.
2. Components of the liq-liq mixture should include volatile liquids like acetone, methylacetate, ethylacetate, isopropylalcohol, ethyl alcohol, EMK and non volatile liquids like chlorobenzene , bromobenzene, aniline, N,N dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.
3. Components of the liq- solid mixture should include volatile liquids like acetone, methylacetate, ethylacetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral.
4. A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture.
5. After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.
6. After separation into component A and component B, the compound to be identified can be decided by examiner.

References:

4. Practical organic chemistry – A. I. Vogel
5. Practical organic chemistry – H.Middleton.
6. Practical organic chemistry – O.P.Aggarwal.

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University of Mumbai

No. UG/ 36 of 2019-20

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 No. UG/95 of 2015-16, dated 5th October, 2015 relating to the revised syllabus as per (CBSGS) for the T.Y.B..Sc. Botany (Sem. V & VI).

They are hereby informed that the recommendations made by the Board of Studies in Botany at its meeting held on 18th March, 2019 have been accepted by the Academic Council at its meeting held on 10th May, 2019 **vide** item No. 4.26 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T. Y .B.Sc. Botany in (Sem. V & VI) has been brought into force with effect from the academic year 2019-20, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Ajay Deshmukh)
REGISTRAR

MUMBAI – 400 032
03rd July, 2019

To

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

A.C./4.26/10/05/2019

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No. UG/ 36 -A of 2019 MUMBAI-400 032 3rd July, 2019

Copy forwarded with Compliments for information to:-

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

(Dr. Ajay Deshmukh)
REGISTRAR

University of Mumbai

UNIVERSITY OF MUMBAI

Syllabus for the T.Y.B.Sc.
Program: B.Sc. Course: BOTANY

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

T.Y.B.Sc. Botany Syllabus
Restructured for Credit Based and Grading System
To be implemented from the Academic year 2019-2020

SEMESTER V

Course Code	UNIT	TOPICS	Credit	L / Weeks
USBO501	PLANT DIVERSITY III			
	I	Microbiology	2.5	1
	II	Algae		1
	III	Fungi		1
	IV	Plant Pathology		1
USBO502	PLANT DIVERSITY IV			
	I	Paleobotany	2.5	1
	II	Angiosperms I		1
	III	Anatomy I		1
	IV	Palynology		1
USBO503	FORM AND FUNCTION III			
	I	Cytology and Molecular Biology	2.5	1
	II	Plant Physiology I		1
	III	Environmental Botany		1
	IV	Plant Tissue Culture		1
USBO504	CURRENT TRENDS IN PLANT SCIENCES II			
	I	Ethnobotany and Mushroom Industry	2.5	1
	II	Plant Biotechnology I		1
	III	Instrumentation		1
	IV	Pharmacognosy and medicinal botany		1
USBOP5	Practicals based on Two Courses in Theory (501 & 502) – For 6 Units		3	8
USBOP6	Practicals based on Two Courses in Theory (503 &504) – For 6 Units		3	8
USBOP7	Practicals based on Two Courses in Theory (502 & 503) – For 3 Units		3	8
			16	32 + 8 (3 Units)

SEMESTER VI

Course Code	UNIT	TOPICS	Credit	L / Weeks
USBO601	**PLANT DIVERSITY III**			
	I	**Bryophyta**	**2.5**	**1**
	II	**Pteridophyta**		**1**
	III	**Bryophyta and Pteridophyta: Applied Aspects**		**1**
	IV	**Gymnosperms**		**1**
USBO602	**PLANT DIVERSITY IV**			
	I	**Angiosperms II**	**2.5**	**1**
	II	**Anatomy II**		**1**
	III	**Embryology**		**1**
	IV	**Plant Geography**		**1**
USBO603	**FORM AND FUNCTION III**			
	I	**Plant Biochemistry**	**2.5**	**1**
	II	**Plant Physiology II**		**1**
	III	**Genetics**		**1**
	IV	**Biostatistics**		**1**
USBO604	**CURRENT TRENDS IN PLANT SCIENCES II**			
	I	**Plant Biotechnology II**	**2.5**	**1**
	II	**Bioinformatics**		**1**
	III	**Economic Botany**		**1**
	IV	**Post Harvest Technology**		**1**
USBOP8	**Practicals based on Two Courses in theory (601 & 602) – For 6 Units**		**3**	**8**
USBOP9	**Practicals based on Two Courses in theory (603 & 604) – For 6 Units**		**3**	**8**
USBOP10	**Practicals based on Two Courses in theory (602 & 603) – For 3 Units**		**3**	**8**
			16	**32 + 8 (3 Units)**

BSc BOTANY: PROGRAM OUTCOMES

Specific core discipline knowledge

- Students can recall details and information about the evolution, anatomy, morphology, systematics, genetics, physiology, ecology, and conservation of plants and all other forms of life.
- Students can recall details of the unique ecological and evolutionary features of the local and Indian flora.

Communication skills

- Students can communicate effectively using oral and written communication skills

Problem solving and research skills

- Students can generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context

BSc BOTANY: PROGRAM SPECIFIC OUTCOMES

- To recognize and identify major groups of non-vascular and vascular plants and their phylogenetic relationships.
- To understand the phylogeny of plants and study various systems of classification.
- To explore the morphological, anatomical, embryological details as well as economic importance of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.
- To understand physiological processes and adaptations of plants.
- To provide knowledge about environmental factors and natural resources and their importance in sustainable development.
- To be able to carry out phytochemical analysis of plant extracts and application of the isolated compounds for treatment of diseases.
- To be able to deal with all microbes and the technologies for their effective uses in industry and mitigation of environmental concerns.
- To explain how current medicinal practices are often based on indigenous plant knowledge and to get introduced to different perspectives on treating ailments according to ethnomedicinal principles.
- To understand patterns of heredity and variation among individuals, species and populations and apply principles for improvement of quality and yield.
- To be able to apply statistical tools to gain insights into significantly different data from different sources.
- To acquire recently published knowledge in molecular biology, such as rDNA technology; PTC and bioinformatics and their applications.

SEMESTER V
THEORY

Course Code	Title	Credits
USBO501	**PLANT DIVERSITY – III**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To gain knowledge about microbial diversity and techniques for culturing and visualization.
- To understand the salient features of three major groups of algae, their life cycle patterns with a suitable example; to be able to identify them.
- To learn the general characteristics and classification of two major groups of fungi along with life cycles of each group; to be able to identify them.
- To understand the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.

Unit I: Microbiology • **Types of Microbes:** Viruses, Bacteria, Algae, Fungi, Protozoa, Mycoplasma and Actinomycetes. • **Culturing:** Sterilization, media, staining, colony characters. • Pure cultures	**(15 lectures)**
Unit –II: Algae (G.M. Smith Classification System to be followed) • Division Rhodophyta: Classification and General Characters: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, Alternation of Generations, Economic Importance. • Structure, life cycle and systematic position of *Polysiphonia, Batrachospermum.* • Classification and General Characters of Xanthophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. • Structure, life cycle and systematic position of *Vaucheria.* • Classification and General Characters of Bacillariophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. • Structure, life cycle and systematic position of *Pinnularia.*	**(15 lectures)**
Unit III: Fungi (G.M. Smith Classification System to be followed) • Basidiomycetes: Classification and General characters ➢ Life cycle of *Agaricus* ➢ Life cycle of *Puccinia* • Deuteromycetae: Classification and General Characters • Life cycle of *Alternaria*	**(15 lectures)**

Unit IV: Plant Pathology • **Study of plant diseases:** Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following. ➢ White Rust –*Albugo candida* ➢ Tikka disease of ground nut: *Cercospora* ➢ Damping off disease: *Pythium* ➢ Citrus canker –*Xanthomonas axonopodis* pv. citri ➢ Leaf curl – leaf curl virus in *Papaya.* • Study of Physical, chemical and biological control methods of plant diseases.	**(15 lectures)**

Course Code	Title	Credits
USBO502	**PLANT DIVERSITY – IV**	**2.5 Credits (60 lectures)**

Course outcomes:

The students would be able :

- To acquire knowledge of different fossil forms and understand their role in evolution.
- To provide plant description, describe the morphological and reproductive structures of seven families and also identify and classify according to Bentham and Hooker's system.
- To gain proficiency in the use of keys and identification manuals for identifying any unknown plants to species level.
- To relate anomalies in internal stem structure with function and appreciate the salient features of the root stem transition zone.
- To get exposure to pollen study and learn to apply it in various fields.

Unit I: Paleobotany • *Lepidodendron*– All form genera root, stem, bark, leaf, male and female fructification. • *Lyginopteris*– All form genera root, stem, leaf, male and female fructification. • *Pentoxylon*– All form genera. • Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow	**(15 lectures)**
Unit II: Angiosperms I • Morphology of flower – All Parts of Flower. • Complete classification of Bentham and Hooker (only for prescribed families), Merits and demerits • Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families. (Special stress on fruit morphology to be given) ➢ Capparidaceae ➢ Umbelliferae ➢ Cucurbitaceae ➢ Rubiaceae ➢ Solanaceae ➢ Commelinaceae ➢ Graminae	**(15 lectures)**
Unit III: Anatomy I • **Anomalous secondary growth** in the Stems of *Bignonia*, *Salvadora*, *Achyranthes*, *Dracaena*. Storage roots of Beet, Radish • **Root stem transition** • **Types of Stomata**– Anomocytic, Anisocytic, Diacytic, Paracytic, and Graminaceous	**(15 lectures)**

Unit IV: Palynology ● **Pollen Morphology** ● **Pollen viability**–storage ● Germination and growth of pollen ● Application of Palynology in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science	**(15 lectures)**

Course Code	Title	Credits
USBO503	**FORM AND FUNCTIONS- II**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To acquire knowledge about two important organelles and molecular mechanisms of translation
- To understand water relations of plants, inorganic and organic solute transport, and apply the knowledge to manage mineral nutrition and survival in challenging abiotic stresses.
- To understand succession in plant communities and study remediation technologies in order to apply knowledge acquired for cleanup of polluted sites.
- To get exposure to principles and techniques of plant tissue culture and apply these studies for improving agriculture and horticulture and to become an entrepreneur.

Unit I: Cytology and Molecular Biology • Structure and function of nucleus • Structure and function of vacuole • Structure and function of giant chromosomes • The genetic code: Characteristics of the genetic code • Translation in Prokaryotes and Eukaryotes.	**(15 lectures)**
Unit II: Plant Physiology I • **Water relations:** Potential, osmosis, transpiration, imbibition, • **Solute transport:** Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps. • **Translocation of solutes:** Composition of phloem sap, girdling experiment. • **Pressure flow model (Munch's hypothesis):**Phloem loading and unloading, anatomy of sieve tube elements and mechanisms of sieve tube translocation. • **Mineral Nutrition:** Role of Macro and Micro nutrients, physiological functions and deficiency symptoms.	**(15 lectures)**
Unit III: Environmental Botany • **Bioremediation:** Principles, factors responsible and microbial population in bioremediation. • **Phytoremediation**: Metals, Organic pollutants • **Plant succession**: Hydrosere and Xerosere – Formation of Barren Space, Succession on the Land Citing Different Seres leading up to the Climax, Succession in Water, Ecesis, Poly and Mono-climax theories.	**(15 lectures)**
Unit IV: Plant Tissue Culture • **Aspects of Micro-propagation with reference to Floriculture:** Detailed study of Orchid Cultivation • **Plant cell suspension cultures for the production of secondary metabolites:** With special reference to Shikonin production. • Somatic Embryogenesis and Artificial Seeds. • **Protoplast Fusion and Somatic Hybridization:** i) Concept, Definition, and various methods of Protoplast Fusion ii) Applications of Somatic Hybridization in Agriculture	**(15 lectures)**

Course Code	Title	Credits
USBO504	**CURRENT TRENDS IN PLANT SCIENCES – II**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To get exposure to the technique of mushroom cultivation and explore the possibility of entrepreneurship in the same.
- To learn ethnobotanical principles, applications and utilize indigenous plant knowledge for the cure of common human diseases and improvement of agriculture.
- To gain knowledge about the latest molecular biology techniques for isolation and characterization of genes.
- To learn principles and application of commonly used techniques in instrumentation.
- To gain proficiency in the monograph study and pharmacognostic analysis of six medicinal plants.

Unit I: Ethnobotany and Mushroom Industry • **Ethnobotany**- Definition, history, sources of data and methods of study. • **Applications of ethnobotany:** ➢ Ethno-medicines. ➢ Agriculture. ➢ Edible plants. • **Traditional medicines** used by tribals in Maharashtra towards ➢ Skin ailments: *Rubia cordfolia, Sandalwood* ➢ Liver ailments: *Phyllanthus, Andrographis* ➢ Wound healing and ageing: *Centella, Typha, Terminalia, Tridax.* ➢ Fever: *Vitex negundo*, *Tinospora cordifolia* leaves ➢ Diabetes: *Momordica charantia, Syzygium cuminii* • **Mushroom industry:** ➢ Detail general account of production of mushrooms with respect to methods of Composting, spawning, casing, harvesting of mushroom. Cultivation of *Pleurotus, Agaricus, Volvariella* mushroom. ➢ General account of mushrooms: Nutritional value, picking and packaging, economic importance.	**(15 lectures)**
Unit II: Plant Biotechnology I • Construction of genomic DNA libraries, Chromosome libraries and c- DNA libraries. • Identification of specific cloned sequences in c-DNA libraries and Genomic libraries • **Analysis of genes and gene transcripts –**Restriction enzyme, analysis of cloned DNA sequences. Hybridization(Southern Hybridization)	**(15 lectures)**
Unit III: Instrumentation • **Colorimetry and Spectrophotometry** (Visible, UV and IR) – Instrumentation, working, principle and applications. • **Chromatography:** General account of Column chromatography. Principle and bedding material involved in adsorption and partition chromatography, ion exchange chromatography, molecular sieve chromatography.	**(15 lectures)**

Unit IV: Pharmacognosy and Medicinal Botany • Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- *Strychnos* seeds, *Senna* leaves, Clove buds, *Allium sativum, Acorus calamus* and *Curcuma longa*	**(15 lectures)**

SEMESTER V
PRACTICAL

Minimum marks for passing: 20

Semester V USBOP5 – For 6 Units	**Cr**
PRACTICAL PAPER I–PLANT DIVERSITY III – USBOP 501 (For 6 Units)	**1.5**
Microbiology • Study of aeromicrobiota by petriplate exposed method: Fungal culture, Bacterial culture. • Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected microorganism. • Study of antimicrobial activity by the disc diffusion method.	
Algae (G.M. Smith Classification System to be followed) • Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides. ➢ *Polysiphonia* ➢ *Batrachospermum* ➢ *Vaucheria* ➢ *Pinnularia*	
Fungi (G.M. Smith Classification System to be followed) • Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides ➢ *Agaricus* ➢ *Puccinia* ➢ *Alternaria*	
Plant Pathology • Study of the following fungal diseases: ➢ White rust in Cruciferae (Brassicaceae) ➢ Tikka disease in Groundnut ➢ Damping off disease ➢ Citrus canker ➢ Leaf curl in *Papaya Leaf*	
Semester V USBOP7 – For 3 Units	
PRACTICAL PAPER II–PLANT DIVERSITY IV USBOP 502 (For 3 & 6 Units)	**Cr**
Paleobotany • Study of the following form genera with the help of permanent slides/ photomicrographs. ➢ *Lepidodendron* ➢ *Lyginopteris* ➢ *Pentoxylon*	**1.5**
Angiosperms I • Morphology of Flower – All Parts of Flower • Study of one plant from each of the following Angiosperm families as per Bentham and Hooker's system of classification. ➢ Capparidaceae ➢ Umbelliferae ➢ Cucurbitaceae	

➢ Rubiaceae ➢ Solanaceae ➢ Commelinaceae ➢ Graminae • Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families • Identifying the genus and species of a plant with the help of Flora	
Anatomy I • Study of anomalous secondary growth in the stems of the following plants using double staining technique. *1) Bignonia* *2) Salvadora* *3) Achyranthes* *4) Dracaena* • Study of anomalous secondary growth in the roots of 1) Beet 2) Radish • Types of Stomata 1) Anomocytic 2) Anisocytic 3) Diacytic 4) Paracytic 5) Graminaceous	
Palynology I • Study of pollen morphology (NPC Analysis) of the following by Chitale's Method ➢ *Hibiscus* ➢ *Datura* ➢ *Ocimum* ➢ *Crinum* ➢ *Pancratium* ➢ *Canna* • Determination of pollen viability • Pollen analysis from honey sample – unifloral and multifloral honey • Effect of varying concentration of sucrose on *In vitro* Pollen germination	
Total Credit	**3**

Semester V USBOP6 – For 6Units **Semester V USBOP7 – For 3Units**	**Cr**
PRACTICAL –PAPER III FORM AND FUNCTION II USBOP 503 (For 3 & 6 Units)	**1.5**
Cytology and Molecular Biology • Mounting of Giant chromosomes from *Chironomous* larva • Smear preparation from *Tradescantia* buds • Predicting the sequence of amino acids in the polypeptide chain that will be formed following translation(Eukaryotic)	
Plant Physiology I • Estimation of Phosphate phosphorus (Plant acid extract) • Estimation of Iron (Plant acid extract) Note: Preparation of a standard graph and determination of the multiplication factor for Phosphate / Iron estimation using a given standard phosphate / Standard Iron solution should be done in regular practical as this will also be put as a question in practical exam	
Environmental Botany • Estimation of the following in given water sample ➢ Dissolved oxygen demand ➢ Biological oxygen demand ➢ Hardness ➢ Salinity and Chlorinity	
Micropropogation • Plant Tissue culture: • Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis • Preparation of stock solutions for preparation of MS medium (Note: Concept of preparation of specified molar solutions should be taught and problems based on preparation of stock solutions for tissue culture media will be given).	
Semester V USBOP6 – For 6 Units	
PRACTICAL – PAPER IV CURRENT TRENDS IN PLANT SCIENCES II USBOP 504 (For 6 Units)	**Cr**
Ethnobotany and mushroom industry • Study of plants mentioned in theory for Ethnobotany • Mushroom cultivation (To be demonstrated) • Identification of various stages involved in mushroom cultivation – spawn, pin head stage, mature/ harvest stage of *Agaricus, Pleurotus, Volvariella*	**1.5**
Biotechnology I • Growth curve of E. coli • Plasmid DNA isolation and Separation of DNA using AGE • Restriction mapping (problems), Southern blotting	
Instrumentation • Demonstration of Beer Lambert's Law • Experiment based on ion exchange chromatography for demonstration • Experiment based on separation of dyes/ plant pigments using silica gel column.	

Pharmacognosy • Macroscopic/ Microscopic characters and Chemical tests for active constituents of the following plants. ➢ *Allium sativum* ➢ *Acorus calamus* ➢ *Curcuma longa* ➢ *Senna angustifolia* ➢ *Strychnos nux-vomica* ➢ *Eugenia caryophyllata*	
Total Credit	**3**

Course Code	Title	Credits
USBO601	**PLANT DIVERSITY – III**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To identify, describe and study in detail the life cycles of three Bryophytes.
- To and study in detail classification and general characters of three classes of Pteridophytes and identify as well as describe the life cycles of one example from each class.
- To study evolutionary aspects and economic utilization of Bryophytes and Pteridophytes.
- To identify, describe and study in detail the life cycles of three Gymnosperms.

Unit I: Bryophyta (G. M. Smith Classification system to be followed) • Life cycle of *Marchantia* • Life cycle of *Pelia* • Life cycle of *Sphagnum*	**(15 lectures)**
Unit II: Pteridophyta (G. M. Smith Classification System to be followed) • Lepidophyta – Classification, general characters; Life cycle of • *Lycopodium* • Calamophyta – Classification, general characters; Life cycle of • *Equisetum* • Pterophyta - Classification, general characters; Life cycle of *Adiantum* and *Marselia*	**(15 lectures)**
Unit III: Bryophytes and Pteridophytes: Applied aspects • Ecology of Bryophytes. • Economic importance of Bryophytes. • Bryophytes as Indicators. • Evolution of Sporophyte and Gametophyte in Bryophytes. • Economic importance of Pteridophytes • Diversity and distribution of Indian Pteridophytes • Types of Sori and Evolution of Sori in Pteridophytes.	**(15 lectures)**
Unit IV: Gymnosperms (Chamberlain's Classification System to be followed) • Life cycle of *Thuja*, • Life cycle of *Gnetum* • Life cycle of *Ephedra*. • Economic importance of Gymnosperms	**(15 lectures)**

Course Code	Title	Credits
USBO602	**PLANT DIVERSITY – IV**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To study contribution of Botanical gardens, BSI to Angiosperm study and provide plant description, describe the morphological and reproductive structures of seven families.
- To gain exposure to a phylognetic system of classification.
- To gain insight into the anatomical adaptations of different ecological plant groups.
- To understand development plant of male and female gametophytes, embryonic structure and development.
- To understand the different aspects and importance of Biodiversity and utilize them for conservation of species so as to prevent further loss or extinction of Biodiversity and preserve the existing for future generations.

Unit I: Angiosperms II — **(15 lectures)**

- **Major Botanic gardens of India**– Indian Botanic Garden, Howrah; National Botanic Garden (NBRI) Lucknow; Lloyd Botanic Garden, Darjeeling; Lalbaugh Botanic Garden, Bangaluru.
- Botanical survey of India and regional branches of India
- Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic importance, medicinal importance and fruit morphology for members of the families
  - Rhamnaceae
  - Combretaceae
  - Asclepiadaceae
  - Labiatae
  - Euphorbiaceae
  - Cannaceae
- Hutchinson's classification system of Angiosperms Brief Introduction, Merits and Demerits of Hutchinson's Classification System

Unit II: Anatomy II — **(15 lectures)**

- **Ecological anatomy**
  - Hydrophytes – submerged, floating, rooted
  - Hygrophytes -*Typha*
  - Mesophytes
  - Sciophytes
  - Halophytes
  - Epiphytes
  - Xerophytes

Unit III: Embryology — **(15 lectures)**

- **Microsporogenesis**
- **Megasporogenesis**- Development of monosporic type, examples of all embryo sacs
- Types of ovules
- Double fertilization
- Development of embryo–*Capsella*

Unit IV: Plant Geography (Shifted from Paper – IV) • **Phytogeographical regions of India**. • **Biodiversity**: ➢ Definition, diversity of flora found in various forest types of India ➢ Levels of biodiversity ➢ Importance and status of biodiversity ➢ Loss of biodiversity ➢ Conservation of biodiversity ➢ Genetic diversity- Molecular characteristics	**(15 lectures)**

Course Code	Title	Credits
USBO603	**FORMS AND FUNCTION – III**	**2.5 Credits 60 Lectures)**

Course outcomes:

The students would be able :

- To study various plant biomolecular structures and appreciate the structures, role, functions and applications of enzymes.
- To gain insight into the Nitrogen and plant hormone metabolism with applications of the same in agriculture and horticulture.
- To understand principles of genetic mapping , mutations and solve problems based on them, gain knowledge of various metabolic disorders and their implications.
- To generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context, using suitable statistical techniques.

Unit I: Plant Biochemistry • **Structure of biomolecules:** Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids) • **Enzymes:** Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis-Menten equation, competitive, non-competitive and un-competitive inhibitors.	**(15 lectures)**
Unit II: Plant Physiology II • **Nitrogen Metabolism:** Nitrogen cycle, root nodule formation, and leghaemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilization. • Physiological effects and commercial applications of Auxins, Gibberillins, Cytokinins and Abscisic acid	**(15 lectures)**
Unit III: Genetics • **Genetic mapping in eukaryotes:** discovery of genetic linkage, gene recombination, construction of genetic maps, three- point crosses and mapping chromosomes, problems based on the same • **Gene mutations:** definition, types of mutations, causes of mutations, induced mutations, the Ame's test • **Metabolic disorders**– enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenyl ketone urea.	**(15 lectures)**
Unit IV: Biostatistics (Shifted from Paper – II) • Test of significance student's *t*-test – Paired and Unpaired. • Regression. • ANOVA (one way).	**(15 lectures)**

Course Code	Title	Credits
USBO604	**Current Trends in Plant Science – II**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To gain insight into recent molecular biology techniques for DNA analysis and amplification and Barcoding techniques and applications therein.
- To understand and apply tools of Bioinformatics for data retrieval and phylogenetic analysis.
- To learn about the sources of economically important plants in the field of fats and oils and apply it for extraction, dealing with entrepreneurship in the field.
- To gain knowledge and proficiency in preservation of post harvest produce and explore the possibility of entrepreneurship in the field.

Unit I: Plant Biotechnology II • **DNA sequence analysis**– Maxam – Gilbert Method and Sanger's method, Pyro Sequencing. • Polymerase Chain Reaction (PCR). • **DNA barcoding:** Basic features, nuclear genome sequence, chloroplast genome sequence, *rbc*L gene sequence, *mat* K gene sequence, present status of barcoding in plants.	**(15 lectures)**
Unit IV: Bioinformatics (Shifted from Paper – III) • Organization of biological data, databases • Exploration of data bases, retrieval of desired data, BLAST. • Protein structure analysis and application • Multiple sequence analysis and phylogenetic analysis	**(15 lectures)**
Unit III: Economic Botany • **Essential Oils:** Extraction, perfumes, perfume oils, oil of Rose, Sandalwood, *Patchouli*, *Champaca*, grass oils: *Citronella*, Vetiver. • **Fatty oils:** Drying oil (Linseed and Soyabean oil), semidrying oils (Cotton seed, Sesame oil) and non-drying oils (Olive oil and Peanut oil), • **Vegetable Fats**: Coconut and Palm oil	**(15 lectures)**
Unit IV : Post Harvest Technology • **Storage of Plant Produce –**Preservation of Fruits and Vegetables ➢ Drying (Dehydration) – Natural conditions – Sun drying, Artificial Drying – Hot Air Drying, Vacuum Drying, Osmotically Dried Fruits, Crystallized or Candied Fruits, Fruit Leather, Freeze Drying) ➢ Freezing (Cold Air Blast System, Liquid Immersion method, Plate Freezers, Cryogenic Freezing, Dehydro-Freezing, Freeze Drying), ➢ Canning ➢ Pickling (in Brine, in Vinegar, Indian Pickles) ➢ Sugar Concentrates (Jams, Jellies, Fruit juices) ➢ Food Preservatives ➢ Use of Antioxidants in Preservation	**(15 lectures)**

SEMEST ER VI
PRACTICAL

Minimum marks for passing: 20

SEMESTER VI USBOP8 – FOR 6 UNITS	**Cr**
PRACTICAL PAPER I–PLANT DIVERSITY III – USBOP 601(For 6 Units)	**1.5**
Bryophyta (G.M. Smith Classification System to be followed) • Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides ➢ *Marchantia* ➢ *Pelia* ➢ *Sphagnum*	
Pteridophyta (G.M. Smith Classification System to be followed) • Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides ➢ *Lycopodium* ➢ *Equisetum* ➢ *Adiantum* ➢ *Marselia*	
Bryophytes and Pteridophytes: Applied aspects • Economic importance of Bryophyta • Economic importance of Pteridophyta • Types of Sporophytes in Bryophyta (from Permanent slides) • Types of Sori and Soral Arrangement in Pteridophytes	
Gymnosperms (Chamberlain's Classification System to be followed) • Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides ➢ *Thuja* ➢ *Gnetum* ➢ *Ephedra* • Economic importance of Gymnosperms	
USBOP10 – FOR 3 UNITS	
PRACTICAL PAPER II–PLANT DIVERSITY IV USBOP602 (For 3 & 6 Units)	**1.5**
Angiosperms II • Study of one plant from each of the following Angiosperm families as per Bentham and Hooker's system of classification. ➢ Rhamnaceae ➢ Combretaceae ➢ Asclepiadaceae ➢ Labiatae ➢ Euphorbiaceae ➢ Cannaceae • Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families • Identify the genus and species with the help of flora	

Anatomy II • Study of Ecological Anatomy of ➢ Hydrophytes: *Hydrilla* stem, *Nymphaea* petiole, *Eichhornia* offset ➢ Epiphytes: Orchid ➢ Sciophytes: *Peperomia* leaf ➢ Xerophytes: *Nerium* leaf, *Opuntia phylloclade* ➢ Halophytes: *Avicennia* leaf and pneumatophore, *Sesuvium* / *Sueda* leaf ➢ Mesophytes: *Vinca* leaf	
Embryology • Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs • Mounting of Monocot (Maize) and Dicot (Castor and Gram)embryo • *In vivo* growth of pollen tube in *Portulaca /Vinca*	
Plant Geography • Study of phytogeographic regions of India • Preparation of vegetation map using Garmin's GPS Instrument • Problems based on Simpson's diversity Index	
Total Credit	**3**
SEMESTER VI USBOP9 – FOR 6 UNITS	**Cr**
SEMESTER VI USBOP10 – FOR 3 UNITS	
PRACTICAL PAPER III–FORM AND FUNCTION III USBOP603 (For 3 & 6 Units)	**1.5**
Plant Biochemistry • Estimation of proteins by Biuret method • Effect of temperature on the activity of amylase • Effect of pH on the activity of amylase • Effect of substrate variation on the activity of amylase	
Plant Physiology II • Determination of alpha-amino nitrogen • Effect of GA on seed germination • Estimation of reducing sugars by DNSA method	
Genetics • Problems based on three-point crosses, construction of chromosome maps • Identification of types of mutations from given DNA sequences • Study of mitosis using pre-treated root tips of *Allium*	
Biostatistics • *t*-test (paired and unpaired) • Problems based on regression analysis • ANOVA (One Way)	
PRACTICAL PAPER IV CURRENT TRENDS IN PLANT SCIENCES USBOP 604 (For 6 Units)	
Plant Biotechnology II • DNA sequencing by Sanger's Method and Pyro Sequencing Method • DNA barcoding of plant material by using suitable data	

Bioinformatics • BLAST: nBLAST, pBLAST • Multiple sequence alignment • Phylogenetic analysis • RASMOL/SPDBV	
Economic Botany • Demonstration: Extraction of essential oil using Clevenger • Thin layer chromatography of essential oil of *Patchouli* and *Citronella* • Saponification value of Palm oil	
Post-Harvest Technology • Preparation of ➢ Squash ➢ Jam ➢ Jelly ➢ Pickle	
Total Credit	**3**

Scheme of Examinations:

Theory Course: Semester End Assessment	**100 Marks Each Theory Paper**
Practical Course	**50 Marks Each Practical Paper**

- **Students offering Double major (3 Units) will study Paper II and III**

Semester End Theory Examination Question Paper Pattern:

Q.1 – Four (4) Long Answer Questions on Unit – I out of which Two (2) to be solved.	**10 Marks Each**
Q.2 – Four (4) Long Answer Questions on Unit – II out of which Two (2) to be solved.	**10 Marks Each**
Q.3 – Four (4) Long Answer Questions on Unit – III out of which Two (2) to be solved.	**10 Marks Each**
Q.4 – Four (4) Long Answer Questions on Unit – IV out of which Two (2) to be solved.	**10 Marks Each**
Q.5 – Six (6) Short Answer Questions on all four (4) Units out of which Four (4) to be solved.	**05 Marks Each**

Note:

1. Minimum Marks of 20 are required in Every Practical Paper Examination in each semester.
2. A minimum of four field excursions (with at least one beyond the limits of Mumbai / Local area) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.
3. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of T.Y.B.Sc. Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of T.Y.B.Sc. Botany as per the minimum requirements. In case of loss of journal, a candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP5)

Plant Diversity III (USBOP501)

Practical Paper – I

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the given Microbiological Experiment **'A'**	12
Q.2	Identify, Classify and Describe Specimens **B, C** and **D**. Sketch neat and labeled diagrams of Morphological / Microscopical structures seen in the specimens.	24
Q.3	Identify and describe slides / specimens **E, F** and **G**.	09
Q.4	Journal	05

KEY:

A– Any one experiment out of four as prescribed in syllabus.

B & **C**– Algae.

D– Fungi.

E, F & **G**– Plant Pathology, Algae or Fungi not asked above in random order.

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP5)

Plant Diversity IV (USBOP502)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1A. Classify specimen **'A'** up to their families giving reasons. Give floral formula. Sketch neat and labeled L. S. of flower and T.S. ovary. 10

Q. 1B. Identify genus and species of specimen **'B'** using flora. 05

Q.2 Make a temporary double stained preparation of T.S. specimen **'C'** and comment on the type of secondary growth. 06

Q.3 Perform the Palynology experiment **'D'** allotted to you. 07

Q.4 Identify and describe slide/ specimen **'E', 'F', 'G'** & **'H'**. 12

Q.5 Field report 05

Q.6 Viva voce (based on Paper I and Paper II). 05

KEY

A– Families of T.Y.B.Sc only

B– Plants from F.Y & S.Y. B. Sc Families to be included

C– Anatomy Anomalous Secondary Growth

D– As per slip

E, F, G & **H**– Fossils, Types of Stomata, Morphology of flower & Morphology of Fruits Studied in Theory – in random order

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP6)

FORMS AND FUNCTION III (USBOP503)

Practical Paper – III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Make a smear preparation of material **'A'** and show the slide to the Examiner. Comment on your observation / Expose the giant chromosomes from the salivary glands of *Chironomous* larva.	08
Q. 2	Perform the experiment **'B'** allotted to you (Physiology).	12
Q. 3	Perform the experiment **'C'** allotted to you (Ecology).	12
Q. 4.	Calculate the_____of the given solution **'D'** to prepare the required solution.	07
Q. 5.	Identify and describe slide/specimen **'E'** & **'F'**.	06
Q.6.	Journal.	05

KEY

B– Physiology experiment.

C– Ecology experiment.

D– Plant Tissue Culture.

E & **F**– Multiple shoot culture, Hairy root culture, Somatic embryogenesis, Amino acid sequencing.

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP6)

CURRENT TRENDS IN PLANT SCIENCE II (USBOP504)

Practical Paper – IV

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1.	Perform the experiment **A**– growth curve of *E.coli* / Isolate plasmid DNA and separate using AGE.	12
Q.2.	Perform the experiment **'B'** allotted to you.	10
Q.3.	Describe macroscopical /microscopical character with the help of neat and labelled sketches of specimens **'C'** and **'D'**. Perform the chemical test / TLC to identify the active constituents.	14
Q. 4	Identify and explain the specimens/ photographs **'E', 'F'** and **'G'**.	09
Q. 5.	Journal.	05

KEY

B– Experiment based on Beer- Lambert's Law Experiment on separation of dyes/pigments using silica gel column chromatography

C & **D**–*Allium sativum, Acorus calamus, Curcuma longa, Senna angustifolia, Strychnos nux-vomica Eugenia caryophyllata*

E, F & **G**– any stage of mushroom cultivation, any Plant from ethnobotany, problems on restriction mapping

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP7)

Plant Diversity IV (USBOP502) (For 3 Units)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1A.	Classify specimen **'A'** up to their families giving reasons. Give floral formula. Sketch neat and labelled L.S. of flower and T.S. of ovary.	10
Q. 1B.	Identify genus and species of specimen **'B'** using flora.	05
Q.2	Make a temporary double stained preparation of T.S. specimen **'C'** and comment on the type of secondary growth.	06
Q.3	Perform the Palynology experiment **'D'** allotted to you.	07
Q.4	Identify and describe slide/ specimen **'E', 'F', 'G' & 'H'**.	12
Q.5	Field report	05
Q.6	Journal.	05

KEY

A– Families of T.Y.B.Sc only

B– Plants from F.Y & S.Y. B. Sc Families to be included

C– Anatomy Anomalous Secondary Growth

D– As per slip

E, F, G & **H**– Fossils, Types of Stomata, Morphology of flower & Morphology of Fruits Studied in Theory – in random order

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP7)

FORMS AND FUNCTION III (USBOP503) (For 3 Units)

Practical Paper – III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Make a smear preparation of material **'A'** and show the slide to the Examiner. Comment on your observation / Expose the giant Chromosomes from the salivary glands of *Chironomous* larva.	08
Q. 2	Perform the experiment **'B'** allotted to you (Physiology).	12
Q. 3	Perform the experiment **'C'** allotted to you (Ecology).	12
Q. 4	Calculate the_____of the given solution **'D'** to prepare the required solution.	07
Q. 5	Identify and describe slide/specimen **'E'**& **'F'**.	06
Q.6.	Viva voce (based on Paper II and Paper III).	05

KEY

B– Physiology experiment.

C– Ecology experiment.

D– Plant Tissue Culture.

E & **F**– Multiple shoot culture, Hairy root culture, Somatic embryogenesis, Amino acid sequencing.

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER VI

(USBOP8)

Plant Diversity III (USBOP601)

Practical Paper – I

Duration: 9:00 am to 01:00 pm Max. Marks:50

1	Identify, classify and describe specimen **'A'** and **'B'**. Sketch neat and labelled diagrams of Morphological/Microscopical structures seen in the specimens.	12
2	Identify, classify and describe specimen **'C'** and **'D'**. Sketch neat and labeled diagrams of Morphological/Microscopical structures seen in the specimens.	12
Q.3	Identify, classify and describe specimen **'E'**. Sketch neat and labeled diagrams of Morphological/Microscopical structures seen in the specimens.	06
Q.4	Identify and describe slides/specimen **'F', 'G' 'H', 'I'** & **'J'**.	15
Q.5	Journal.	05

KEY

A & **B**– Bryophytes: *Marchantia, Pellia & Sphagnum*

C & **D**– Pteridophytes: *Lycopodium, Equisetum, Adiantum* & *Marsilea*

E– Gymnosperm: *Thuja, Gnetum & Ephedra*

F, G, H, I & **J**– Economic importance of Bryophytes, Economic importance of Pteridophytes Types of Sporophytes in Bryophyta, Types of Sori in Pteridophytes, Soral arrangement in Pteridophytes, Economic importance of Gymnosperms. (In random order)

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER VI

(USBOP8)

Plant Diversity IV (USBOP602)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1 A.	Classify specimen **'A'** up to its family giving reasons. Give floral formula. Sketch neat and labeled L.S. of flower and T.S. ovary.	08
Q. 1.B.	Identify genus and species of specimen **'B'** using flora.	04
Q. 2	Make a stained preparation of specimen **'C'** and comment on its ecological anatomy.	06
Q.3.A	Calculate Simpson's Diversity Index from the given data **'D'**.	08
Q.3.B	Mark the Phytogeographic region **'E'** in the map of India and Comment on the same.	05
Q.4	Identify and describe slide/specimen **'F', 'G' & 'H'**.	09
Q.5	Field Report.	05
Q.6	Viva voce (based on Paper I and Paper II)	05

KEY

A– Families of T.Y.B.Sc Sem – VI only

B– Plants from F.Y., S.Y. & T.Y. B. Sc**.(**Sem – V Families to be included**)**.

C– Ecological anatomy.

F, G & **H**– Economic importance of specimen from prescribe families (Sem VI only)**,** Morphological Peculiarities of prescribed families (Sem – VI only), Embryology. (In random order)

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI (USBOP9)

FORM AND FUNCTION III (USBOP603)

PRACTICAL III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the experiment **'A'** allotted to you.	10
Q.2	Perform the experiment **'B'** allotted to you.	10
Q.3	Make a squash preparation to show the stage of mitosis from the pre-treated root tips **'C'**.	05
Q.4	Construct a chromosome map from the given data **'D'** / Identify the type of mutation and comment on them (any two types of mutations)	10
Q.5	From the given data/ material **'E'** determine test of significance using students t-test/ Regression Analysis /ANOVA	10
Q.6	Journal.	05

KEY

A– Plant Biochemistry Experiment.

B– Plant Physiology Experiment.

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T.Y.B.Sc. BOTANY SEMESTER VI (USBOP9)

CURRENT TRENDS IN PLANT SCIENCE II (USBOP604)

PRACTICAL IV

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the DNA barcoding of plant material using given data **'A'**.	12
	OR	
	Perform DNA sequencing by Sanger's method of the given sequence **'A'**.	12
Q.3	Perform the experiment **'B'** allotted to you.	12
Q.4	Perform the given analysis of data **'C'** using computer(Bioinformatics).	08
Q.5	Prepare the squash/Jam/jelly/pickle from the given material **'D'**.	12
Q.6	Viva voce. (Based on Paper III and Paper IV)	06

KEY

B– TLC of *Patchouli* or *Citronella* / Saponification value

C– BLAST / Multiple Sequence Alignment (MSA) / Phylogenetic Analysis / RASMOL / SPDBV

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP10)

Plant Diversity IV (USBOP602) (For 3 Units)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1A.	Classify specimen **'A'** up to its family giving reasons. Give floral formula. Sketch neat and labeled L.S. of flower and T.S. ovary.	08
Q. 1.B.	Identify genus and species of specimen **'B'** using flora.	04
Q. 2	Make a stained preparation of specimen **'C'** and comment on its ecological anatomy.	06
Q.3.A	Calculate Simpson's Diversity Index from the given data **'D'**.	08
Q.3.B	Mark the Phytogeographic region **'E'** in the map of India and Comment on the same.	05
Q.4	Identify and describe slide/specimen **'F', 'G'** & **'H'.**	09
Q.5	Field Report.	05
Q.6	Journal	05

KEY

A– Families of T.Y.B.Sc Sem – VI only

B– Plants from F.Y., S.Y. & T.Y. B. Sc.(Sem – V Families to be included).

C– Ecological anatomy.

F, G & **H**– Economic importance of specimen from prescribe families (Sem VI only), Morphological Peculiarities of prescribed families (Sem – VI only), Embryology. (In random order)

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI(USBOP10)

FORM AND FUNCTION III (USBOP603) (For 3 units)

PRACTICAL III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the experiment **'A'** allotted to you.	10
Q.2	Perform the experiment **'B'** allotted to you.	10
Q.3	Make a squash preparation to show the stage of mitosis from the pre-treated root tips **'C'**.	06
Q.4	Construct a chromosome map from the given data **'D'**/ Identify the type of mutation and comment on them (any two types of mutations)	10
Q.5	From the given data/ material **'E'** determine test of significance using students t-test/ Regression Analysis /ANOVA	09
Q.6	Viva-voce. (based on Paper II and Paper III)	05

KEY

A– Plant Biochemistry Experiment.

B– Plant Physiology Experiment.

ReferenceBooks

1. A handbook of Ethnobotany by S.K. Jain, V. Mudgal
2. Plants in folk religion and mythology (Contribution to Ethnobotany by S.K.Jain3rd Rev.Ed).
3. Introduction to Plant Physiology by Noggle and Fritz, Prentice Hall Publishers(2002)
4. Plant Physiology by Salisbury and Ross CBS Publishers
5. Plant Physiology by Taiz and Zeiger Sinauer Associates Inc. Publishers,2002
6. Genetics by Russel Peter Adison Wesley Longman Inc. (5th edition)
7. An introduction to Genetic analysis Griffith Freeman and Company(2000)
8. Fundamentals of Biostatics by Rastogi, Ane Books Pvt. Ltd.(2009).
9. College Botany Vol I and II by Gangulee Das and Dutta Central Education enterprises.
10. Cryptogamic Botany Vol I and II by G M Smith, Mcg raw Hill
11. Industrial Microbiology by Cassida, New Age International, New Delhi
12. Industrial Microbiology Mac Millan Publications, New Delhi
13. Physiological Plant Anatomy by Haberlandt, Mac Millan and Company
14. Ayurveda Ahar by P H Kulkarni
15. Pharmacognosy by Kokate, Purohit and Gokhale, Nirali Publications
16. Bioinformatics by Sunder Rajan
17. Instant Notes on Bioinformatics by Westhead (2002), Taylor Francis Publications.
18. Bioinformatics by Ignasimuthu
19. DNA barcoding plants: taxonomy in a new perspective 2010. K Vijayan and C H Tsou, Current Science, 1530 –1541.
20. Introduction to Biostatistics by P K Banerjee, Chand Publication.
21. Plant Biotechnology by K. Ramawat
22. Practical Biochemistry by David Plummer, McGraw Hill Publ.
23. Economic Botany by A F Hill, TATA McGRAW-HILL Publishing Co. Ltd.
24. Post-Harvest Technology by Verma and Joshi, Indus Publication
25. Embryology of Plants by Bhojwani and Bhatnagar
26. Pollen Morphology and Plant Taxonomy by G. Erdtman, Hafner Publ. Co., N.Y.
27. A text Book of Palynology by K Bhattacharya, New Central Book Agency Pvt. Ltd., London
28. An introduction to Embryology of Angiosperms by P Maheshwari, McGraw Hill Book Co.
29. Plant Systematics by Gurcharan Singh, Oxford and IBH Publ.
30. Taxonomy of Vascular Plants by Lawrence George, H M, Oxford and IBH Publ.

UNIVERSITY OF MUMBAI

No. UG/ 8 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/264 of 2017-18, dated 23rd October, 2017, UG/287 of 2017-18, dated 30th October, 2017and UG/263 of 2017-18, dated 23rd October, 2017 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Physics at its meeting held on 23rd April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.26 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Physics including Applied Component - Electronic Instrumentation (EI) & Computer Course (CS) (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
12th June, 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/4.26/05/05/2018

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No. UG/ 8 -A of 2018 MUMBAI-400 032 12th 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 Physics,
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

UNIVERSITY OF MUMBAI

Syllabus for Sem V & VI Program: B.Sc.

Course: Electronic Instrumentation

(Applied Component)

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

SEMESTER V			
Theory			
USACEI501	**Analog Circuits, Instruments and Consumer Appliances.**	**No. of Credits**	**Lectures/Week**
Unit I	Transducers, Sensors and Optoelectronics Devices	02	04
Unit II	Signal conditioning, SMPS and Measuring Instruments		
Unit III	Data Acquisition and Conversion		
Unit IV	Modern Techniques and Consumer Appliances		
Practicals			
USACEI5P1	**Analog Circuits, Instruments and Consumer Appliances.**	02	04

SEMESTER VI			
Theory			
USACEI601	**Digital Electronics, Microprocessor, Microcontroller and OOP.**	**No. of Credits**	**Lectures/Week**
Unit I	Digital Electronics.	02	04
Unit II	Advanced 8085 Programming and 8255 (PPI) interfacing.		
Unit III	Introduction to Microcontrollers.		
Unit IV	Basic Concepts of Object Oriented Programming and C++.		
Practicals			
USACEI6P1	**Digital Electronics, Microprocessor, Microcontroller and OOP.**	02	04

The revised syllabus under the credit based grading system in the subject of **Electronic Instrumentation** (Applied Component) for Third Year B.Sc. Physics (Single/Twin major subject) will be implemented **from the academic Year 2018-19**

The scheme of examination in the subject of Electronic Instrumentation (Applied Component) will be as follows:

Semester V & VI: Theory

Course Code: USACEI501 & USAEI601

Theory Examination: 100 marks

- Duration of each Theory paper will be of **three** hours.
- Each theory paper shall consist of **five questions**, one from each unit and the fifth question will be from all the units. All questions are compulsory and will have internal choice.
- The theory examination will be conducted by the respective colleges and the marks will be forwarded to the University

Objectives

The objective of these papers is to introduce the students to sensors and transducers, Signal conditioning, data acquisition systems and measuring instruments used in the laboratory. Students are to be exposed to know, in principle, the modern techniques in the field of medical science. To learn PCB designing and working of consumer electronic devices. To develop logic circuit design and implementation. To know advanced programming skills and interfacing techniques. To understand basic building blocks of microcontrollers. To know the terminologies like embedded, CISK and RISK processors. To master Programming and interfacing skills of microprocessor and microcontrollers. To develop object oriented programming skills and programming in C++. To develop various experimental skills.

Expected learning outcomes

Learner will be able to:

- Understand the difference between a transducer and a sensor.
- Understand the construction, working and uses of different types of transducers.
- Understand the concept of signal conditioning, devices used and their operations.
- Get acquainted with the measuring instruments used in laboratory.
- Get the insight of the modern medical instruments in principle, which are used in day to day life.
- Analyze/design and implement combinational logic circuits.
- Develop assembly language programing skills and real time applications of microprocessor.
- Illustrate how to interface the I/O peripheral (PPI) with 8085 microprocessor
- Understand architecture, silent features, instruction set, programming and interfacing of 8051 microcontroller.
- Develop the programming skills in programming Language C++.
- Train their practical knowledge through lab experiments.
- Get practical training to interface different programmable peripherals and I/O devices to microprocessor and microcontroller.

Semester V & VI: Practical

Course Code: USACEI5P1 & USACEI6P1

The practical examination will be conducted as per the following scheme by the respective colleges and the marks will be forwarded to the University:

Sr. No	**Particulars of External Practical Examination**	**Marks**
1	Laboratory Work	80
2	Journal	10
3	Viva	10
	TOTAL	**100**

Total Marks in each semester: **100 Marks**

- Duration of each Practical paper will be of 3 Hours per semester.
- A certified Journal of Electronic Instrumentation must contain a minimum of **EIGHT** Experiments in each semester. At least TWO experiments from each sub groups, as mentioned in the syllabus, should be performed and reported in journal.
- Every candidate will be required to perform ONE experiment (from sub groups A or B or C or D) at the semester end practical examination.
- A candidate will be allowed to appear for the Practical Examination only if the candidate submits his/her certified Journal or a certificate from the Head of the Department of Physics stating that the candidate has completed the practical Course of Electronic Instrumentation of the respective semester as per requirements.

SEMESTER V

COURSE CODE: USACEI501

ANALOG CIRCUITS, INSTRUMENTS AND CONSUMER APPLIANCES.

Unit- I:	**Transducers, Sensors and Optoelectronic Devices**	(15 lect.)
1.	**Transducers:** Definition, Classification, Selection of transducer.	
2.	**Electrical transducers:** Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer. [Ref. 2, 3, 6 & 9]	
3.	**Chemical sensors:** PH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive). [R6, R7].	
4.	**Electronic Weighing Systems:** Operating principle, Block diagram, features [Ref12 & 13].	
5.	**Optoelectronic Devices:** LDR, LED (Construction, Working & Applications), Multicolour LED, Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (construction, Characteristics & applications), Phototransistor. [Ref. 1, 2 & 3]	
Unit-II:	**Signal Conditioning, SMPS and Measuring Instruments**	(15 lect.)
1.	Half wave precision rectifier, Active Peak detector, Active Positive Clamper [M & B].	
2.	Active Positive and Negative Clippers [G]	
3.	**Microphones:** characteristics, types (list only), carbon microphone and dynamic type microphone (principle, construction and working) [R4].	
4.	**Loud speakers:** Characteristics, Dynamic (Moving coil type) speaker, Multi-way speaker system (woofer and tweeter) [R4]	
5.	**Switching Regulators:** Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations) Ref M: 24.7	

6.	**Cathode Ray Oscilloscope:** Single trace CRO (Block diagram), Front Panel Controls (Intensity, Focus, Astigmatism, X & Y position, Level knob, Time base (Time/Division) and attenuation (Volts/Division) knobs, X-Y mode), Dual Trace CRO (Block diagram), Probes: 1:1&10:1. Digital Storage Oscilloscope [R3 &10].	
7.	**DMM:** 3 ½ Digit, resolution and sensitivity, general specification. [R3]	
Unit- III:	**Data Acquisition and Conversion**	(15 lect.)
1.	**Data acquisition system:** Objectives of DAS, Signal conditioning of inputs, Single channel Data Acquisition system, Multichannel Data Acquisition system. [Data Transmission systems IEEE-488 GPIB*] [Ref. 11]	
2.	**D to A Converters:** Resistive divider network, Binary ladder network [Ref 7 & 8]	
3.	**A to D Converters:** Successive approximation type, Voltage to Time (Single slope, Dual slope). [Ref. 7 & 8]	
Unit-IV:	**Modern Techniques and Appliances**	(15 lect.)
1.	**Printed Circuit Board:** Idea of PCB, advantages, copper clad, Etching processes, Principle of Photolithography (For PCB). [Ref. 4, 14 & 15].	
2.	**Microwave Oven:** Operating principle, block diagram, features. [Ref. 12 & 13]	
3.	**Medical instruments:** Bio-Potential, Types of electrodes, ECG, EEG, EMG, CT Scan and MRI (principle, block diagram and features), Ultrasonography: working principle [R 16, 17 and18].	

References:

1.	A Textbook of Applied Electronics – R S Sedha, S Chand & Company, New Delhi.
2.	Basic Electronics Solid state - B. L. Thereja, S Chand & Company, New Delhi.
3.	Electronic Instrumentation – H S Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4.	Electronic components and materials: Principles, Manufacture and Maintenance- S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.

	https://books.google.co.in/books?id=sGbwj4J76tEC&pg=PA384&lpg=PA384&dq=4.+Electronic+components+and+materials:+Principles,+Manufacture+and+Maintenance-+S.+M.+Dhir,+Tata+McGraw-Hill+Publishing+Company+Limited,+New+Delhi.&source=bl&ots=U1ekaiN3pB&sig=viKj6soAvVom4Hx9W-53Q-koqFM&hl=en&sa=X&ved=0ahUKEwjCq97viYXaAhUEPo8KHfMNBaQQ6AEIMjAC#v=onepage&q=4.%20Electronic%20components%20and%20materials%3A%20Principles%2C%20Manufacture%20and%20Maintenance-%20S.%20M.%20Dhir%2C%20Tata%20McGraw-Hill%20Publishing%20Company%20Limited%2C%20New%20Delhi.&f=false. https://books.google.co.in/books?id=bftp5ZG8v5kC&pg=PP1&lpg=PP1&dq=digital+Electronics+-+by+A.P+Godse+%26+D.A+Godse+Technical+publications,+Pune,+Revised+third+edition,+2008&source=bl&ots=_ApVT8Km_H&sig=hfrgOdJHfzdZwEy1_JPogAeRhLE&hl=en&sa=X&ved=0ahUKEwif3ZbKssraAhVFPI8KHVaJBKIQ6AEINTAB#v=onepage&q=digital%20Electronics%20-%20by%20A.P%20Godse%20%26%20D.A%20Godse%20Technical%20publications%2C%20Pune%2C%20Revised%20third%20edition%2C%202008&f=false
5.	Measurement and Instrumentation Principles: Alan S. Morris., Butterworth-Heinemann.
6.	Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7.	Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill.
8.	Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9.	Modern Electronic Instruments and Measurement techniques- Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
10.	A course in electrical and electronic Measurements and Instrumentation: A. K. Sawhney, DhanpatRai and Sons. https://www.scribd.com/document/258017718/A-K-sawhney-A-Course-in-Electrical-and-Electronic-Measurements-and-Instrumentation
11.	Instrumentation Devices & Systems , 2nd Edition Tata McGrawHill- C.S. Rangan, G.R. Sarma,V.S. Mani
12.	Consumer Electronics R. P. Bali, Pearson Education (2008)

13.	S.P Bali, "Consumer Electronics", Pearson Education Asia Pvt., Ltd., 2008 Edition,
14.	Printed Circuits Handbook pdf, Clyde F. Coombs. Jr. , McGraw Hill Handbooks, 6th ed.
15.	PCB design basics, Mahmoud Wahby, EDN Networks, Nov 2013.
16.	Introduction to Bio-medical Electronics: Joseph-Du-bary, McGraw Hill Co. Ltd.
17.	Medical instrumentation Application and design- J. C. Wobster
18.	Biomedical instruments and measurements – L. Cromwell, F. J. Weibell, Printice hall of India of India Pvt. Ltd, New Delhi.

PRACTICALS (Semester V)

Course Code: USACEI5P1

1. Perform Minimum TWO Experiments from each group.
2. **Group C** experiments must be performed on Bread Boards.

GROUP - A	
Sr. No.	**Name of the Experiments**
1	Thermistor Characteristics –Thermal and electrical. (H & C)
2	Thermistor as sensor in temperature to voltage converter using OPAMP. (C&D Ch.8)
3	Study of LVDT characteristics. (K Ch. 13)
4	Study of Load Cell / Strain Guage. (K Ch. 13)
5	Study of seven segment display.
6	Characteristics of Photo diode and photo transistors.

GROUP - B	
Sr. No.	**Name of the Experiments**
1	Basic Instrumentation Amplifier using 3 Op-Amps coupled to resistance bridge. (C & D Ch. 8)
2	Temperature to frequency Conversion using 555 timer. (C & D Ch.13)
3	OPAMP D/A Converter: Binary weighted resistors.
4	OPAMP D/A Converter: Ladder network. (M & L Ch. 12)
5	Sample and hold circuit using op-amp 741. (G Ch. 8)
6	Peak detector using op-amp 741. (G Ch. 8)

GROUP – C (Must be performed on Bread Board)	
Sr. No.	**Name of the Experiments**
1	Half wave precision rectifier using precision op-amps (OPA177) (C & D Ch. 7)
2	Positive and Negative Clippers using op-amp.(G Ch. 8)
3	Positive and Negative Clampers using single power supply op-amp (124/324). (G Ch. 8)
4	Second Order active Low Pass filter (frequency response & phase relation)
5	Second Order active High Pass filter (frequency response & phase relation) (K.Ch15)
6	Active Notch Filter (frequency response & phase relation) (K.Ch.15)
7	Square and Triangular wave generator using OPAMPs with concept of duty cycle (M.Ch 23)

GROUP - D	
Sr. No.	**Name of the Experiments**
1.	Study of variable dual power supply using LM 317& LM 337 (± 3v to ± 15v). (C&D Ch.13)
2.	Constant Current source using OPAMP and PNP transistor (o/p current less than 50 mA) (C & D Ch 5)
3.	Simple microphone amplifier using a transistor.
4.	Low voltage audio amplifier using IC LM386
5.	Construction of Audio power amplifier using IC TBA 810.
6.	Making PCB for simple circuits (like rectifiers, regulators, oscillators, multivibrators, op-amp applications, single stage amplifier etc.), building and testing of the circuit.
7.	Visit to Hospital/Diagnostic Center/ Bio-medical Research Laboratory and submission of its report.

- Experiment No. 5 & 6 are Hands-on experiments. Learner have to prepare report, PPT and viva voice. Which is equivalent to 2 regular experiments.
- Visit to Hospital/Diagnostic Center/ Bio-medical Research Laboratory and submission of its report which is also equivalent to 2 regular experiments.
- Learner will be examined for Expt. No. 5, 6 and 7 on the basis of submitted report, PPT and viva, and need not perform regular experiment during the Practical Examination.

References:

1.	H & C: Modern Electronic Instrumentation & Measurement Techniques by Albert D. Helfrick & William D. Cooper PHI) Edition.
2.	C & D: OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6th edition PHI)
3.	G: OPAMPs and linear integrated circuits by R.A. Gayakwad (4th edition, PHI).
4.	M: Electronic Principles by A. P. Malvino, (PHI), 6th edition.

5.	K: Electronic Instrumentation by H. S. Kalsi, (TMH) 2nd Edition
6.	M & L: Digital Principle and Applications" by Malvino and Leach, (TMH), 5th edition,
7.	RPJ: Modern Digital Electronics, R .P. Jain, (TMH), 3rd edition.

SEMESTER VI

COURSE CODE: USACEI602

DIGITAL ELECTRONICS, MICROPROCESSOR, MICROCONTROLLER AND OOP

Unit- I:	**Digital Electronics**	(15 lect.)
1.	**Combinational Logic Design:** Introduction, Boolean identities, K – map (2, 3 and 4 variable), **Ref: N G P 4.1 – 4.8.** (additional ref. RPJ)	
2.	**Design and implementations of:** Decoders, Encoders, Multiplexers, De-multiplexers, Use of MUX and DEMUX in Combinational Logic design. Code Converters (based on – binary, BCD, Gray and Excess – 3 codes). Tri-State logic, buffers, D latch.	
	Ref: N G P - 5.1 (only introduction), 5.3, 7.1 -7.6 (except 7.5) RPJ - 4.20. RG: 3.5.1, 3.5.2, 3.5.3, 3.5.4 & 3.5.5 NGP: Digital Electronics and Logic design by N G PALAN, https://archive.org/details/hellomr82k_gmail_DE RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition. RPJ: R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition.	

Unit-II:	**Advanced 8085 Programming and 8255(PPI)**	(15 lect.)
1.	Introduction to advanced instructions and applications Ref. RG: 10.7, 10.8, 10.9	
2.	Stack and Subroutines**:** Stack, Subroutine Ref. RG: 9.1, 9.1.1, 9.2&9.2.1	
3.	The 8255 Programmable Peripheral Interface: Block Diagram of the 8255, Mode 0 – Simple Input / Output mode, BSR (Bit Set/Reset Mode) Ref. RG: 15.1.1, 15.1.2& 15.1.3	
	RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition.	
Unit- III:	**Introduction to Microcontrollers**	(15 lect.)
1.	Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Block diagram of 8051 Microcontroller*, Embedded Versus External Memory Devices, 8-bit & 16-bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontrollers. Ref. AVD-Ch: 1 Ref. MMM - For * Refer 1.2 The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R. D. Mckinlay, Second Edition, Pearson.	
2.	**8051 Microcontrollers:** Introduction, MCS-Architecture, Registers in MCS-51, 8051 Pin Description, 8051 Connections, 8051 Parallel I/O Ports, Memory Organization. AVD-Ch: 2, 3.	
3.	**8051 Instruction Set and Programming:** *MCS-51 Addressing Modes and Instructions***:** 8051 Addressing modes, MCS-51 Instruction Set, 8051 Instructions and Simple Programs, Using Stack Pointer AVD-Ch: 4 Ref. AVD: Microcontrollers (Theory and Applications) by Ajay V Deshmukh, The Tata-McGraw-Hill Companies **Ref. Intel's 8031/8051 Data sheet**	

	https://archive.org/details/bitsavers_intel8051M4_15073500 https://www.8051projects.net/download-d215-intel-mcs-51-8051-user-manual.html https://archive.org/stream/212656146The8051MicrocontrollerByIScott Mackenzie4th Edition/212656146-The-8051-Microcontroller-by-I-Scott-Mackenzie-4th-Edition#page/n47/mode/2up Additional Reference books: 1. The 8051 Microcontroller & Embedded Systems-Dr. Rajiv Kapadia (Jaico Pub. House) 2. 8051 Micro-controller by K.J.Ayala., Penram International. 3. Programming & customizing the 8051 microcontroller By Myke Predko, TMH. 4. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R.D.Mckinlay, Second Edition, Pearson.

Unit-IV:	**Basic Concepts of Object Oriented Programming and C++**	(15 lect.)
1.	**Basics of Object-Oriented Programming & Beginning with C++:** Basic concepts of Object-Oriented Programming, Benefits of OOP, Object-Oriented Languages, Applications of OOP. What is C++?, Applications of C++, A simple C++ program, More C++ Statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking. Ref EB: 1.5, 1.6, 1.7 & 1.8 EB: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 & 2.8	
2.	**Tokens and Expressions in C++:** Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Dereferencing Operators, Memory Management Operators, Manipulators, Type Cast Operator, Expressions and Their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence. Ref EB: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22 & 3.23	
3.	**Control Structures and Functions:** Control Structures, Functions: The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Constant Arguments, Function Overloading, Math Library Functions.	

Ref EB: 3.24, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 & 4.11

Reference:
EB: Object Oriented Programming with C++ by E Balagurusamy, Third /Fourth Edition, Tata McGraw-Hill Publishing Company Limited.

Additional references:

1) Microprocessor and Applications by Vibhute and Borole, Techmax Publications,
2) Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH
3) Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited.
4) Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company.
5) Digital Electronics - by A.P Godse & D.A Godse Technical publications, Pune, Revised third edition, 2008. Pg.No:2.25-2.70 (for K-maps).

https://www.scribd.com/document/103027386/Digital-Electronics-By-D-A-Godse-A-P-Godse

https://books.google.co.in/books?id=JkMrIjNKI7IC&pg=PP1&lpg=PP1&dq=Digital+Electronics+-+by+A.P+Godse+%26+D.A+Godse+Technical+publications,+Pune,+Revised+third+edition,+2008&source=bl&ots=9VG8scIgqH&sig=d7cyhWaM7cCwabgqRMoWz6snI8s&hl=en&sa=X&ved=0ahUKEwiv55-j6cbaAhUBvY8KHUZJBmMQ6AEIPTAD#v=onepage&q=Digital%20Electronics%20-%20by%20A.P%20Godse%20%26%20D.A%20Godse%20Technical%20publications%2C%20Pune%2C%20Revised%20third%20edition%2C%202008&f=false

PRACTICALS (Semester VI)

Course Code: USACEI6P1

Note: Perform Minimum TWO Experiments from each group.

GROUP – A: Digital Electronics	
Sr. No.	**Name of the Experiments**
1	Study of 3:8 Decoder (74LS138), 8:3 Priority Encoder (74LS148) and their applications.
2	Study of Latch (74LS373) and its application.
3	Study of 8:1 Multiplexer (74LS151), 1: 4 De-multiplexer (74LS155) and their applications.
4	Study of unidirectional buffer (74LS244) and bidirectional buffer (74LS245).
5	Design using K –map and implement 4:1 MUX, 1:4 DEMUX, 2bit comparator, Full adder and Full subtractor. [Note: Use suitable circuit simulator for implementation]
6	Designing (using K –map) and implementation of code convertors. (any two – Binary to Gray, Gray to Binary, BCD to Excess – 3 and Excess-3 to BCD) [Note: Use suitable circuit simulator for implementation]
GROUP – B : 8085 Advanced Programming and 8255 interfacing **Note:** The students should be familiar with Keyboard and Display utilities such as READ KEYBOARD, TO DISPLAY ON ADDRESS FIELD, and TO DISPLAY ON DATA FIELD, mentioned in the 8085 µp kit's manual.	
Sr. No.	**Name of the Experiments**
8085 programming	
1	Write An ALP: a) To Evaluate simple arithmetic Expression (like Y= a x b + c x d where a, b, c and d are 8-bit HEX numbers) b) To Add parity bit to 7-bit ASCII characters.

2	Write An ALP for code conversion (any two)
3	16-bit Data manipulation (Addition, subtraction) Display result on Address field.
4	Write ALP for Addition/ Subtraction/Multiplication of two, 8-bit hex, numbers. [**Note:** Use Read Keyboard Utility for inputting the hex numbers and display the result on the Address field.]
8255 interfacing	
1.	Design a system (both Software and Hardware) that will cause 4 LEDs to flash when a push button switch is pressed. Assume persistence of vision to be 0.1 seconds.
2.	Design a system (both Software and Hardware) using 8 LED display to demonstrate: a) Binary - up, down and ring counters. b) Flashing display.
3.	Design a system (both Software and Hardware) to control ON/OFF operation of 4 electrical loads (appliances).
4.	Interfacing 8 switches and 8 LEDs to 8255: a) Write ALP to read the status of the switches and display on the LEDs. b) Write ALP so that when the first switch is made ON all the LEDs should glow and when the second switch is made OFF all the LEDs should become off.
GROUP – C: Experiments for 8031 / 8051 / 89C51	
Sr. No.	**Name of the Experiments**
1	**8031/51 assembly language programming:** a) Simple data manipulation programs. (8/16-bit addition, subtraction, multiplication, division. b) 8/16 bit data transfer, cubes of nos., to rotate a 32- bit number c) Finding greatest/smallest number from a block of data, decimal / hexadecimal counter.

2	**Study of IN and OUT port of 8031/51 by Interfacing switches, LEDs and Relays:** a) To display bit pattern on LED's b) To count the number of "ON" switches and display on LED's, c) To trip a relay depending on the logic condition of switches d) Event counter (using LDR and light source)
GROUP – D: C++ Programming	
Sr. No.	**Name of the Experiments**
1.	Program based on Input, Output Statements. (Programs to read any two numbers through keyboard and to perform simple arithmetic operations and to display the result).
2.	Program based on Control Statements a) Program based on if-else statement b) Program based on nested if statement
3.	Program based on for loop, while loop and do-while loop.
4.	Program using switch statements and if-else ladder.
5.	Program to study function declaration, function calling and function prototype.

UNIVERSITY OF MUMBAI

No. UG/ 8 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/264 of 2017-18, dated 23rd October, 2017, UG/287 of 2017-18, dated 30th October, 2017and UG/263 of 2017-18, dated 23rd October, 2017 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Physics at its meeting held on 23rd April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.26 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Physics including Applied Component - Electronic Instrumentation (EI) & Computer Course (CS) (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
12th June, 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/4.26/05/05/2018

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No. UG/ 8 -A of 2018 MUMBAI-400 032 12th 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 Physics,
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

UNIVERSITY OF MUMBAI

SYLLABUS FOR SEM - V & VI

Program: B.Sc.

Course: Physics

(Credit Based Semester and Grading System
w. e. f. the academic year 2018–2019)

T.Y.B.Sc. Physics Syllabus: Credit Based Semester and Grading System to be implemented from the Academic year 2018-2019

SEMESTER V				
Theory				
Course	**UNIT**	**TOPICS**	**Credits**	**Lectures per Week**
USPH501	I	Mathematical Methods in Physics	**2.5**	**4**
	II	Mathematical Methods in Physics		
	III	Thermal and Statistical Physics		
	IV	Thermal and Statistical Physics		
USPH502	I	Solid State Physics	**2.5**	**4**
	II	Solid State Physics		
	III	Solid State Physics		
	IV	Solid State Physics		
USPH503	I	Atomic Physics	**2.5**	**4**
	II	Atomic Physics		
	III	Molecular Physics		
	IV	Molecular Physics		
USPH504	I	Electrodynamics	**2.5**	**4**
	II	Electrodynamics		
	III	Electrodynamics		
	IV	Electrodynamics		
Practicals				
USPHP05	Practicals of Course USPH501 + Course USPH502		**3**	**8**
USPHP06	Practicals of Course USPH503 + Course USPH504		**3**	**8**

Scheme of examination:

External Examination: 100 marks

I.	**Theory:**		
	Each theory paper shall be of **THREE** hours duration.		
	Each paper shall consist of FIVE questions. All questions are compulsory and will have internal options.		
	Q – I :	is from Unit – I	
	Q – II :	is from Unit – II	
	Q – III :	is from Unit - III	
	Q – IV :	is from Unit - IV	
	Q – V :	will consist of questions from all the FOUR Units with equal weightage of marks allotted to each Unit.	
II.	**Practicals:**		
	The External examination per practical course will be conducted as per the following scheme.		
Sr. No.	**Particulars of External Practical Examination**		**Marks%**
1	Laboratory Work		80
2	Journal		10
3	Viva		10
	TOTAL		**100**

A candidate will be allowed to appear for the practical examination only if the candidate submits a certified journal of TYBSc Physics or a certificate from the Head of the Department to the effect that the candidate has completed the practical course of TYBSc Physics as per the minimum requirements.

III. Visits: to industry, national research laboratories, and scientific exhibitions should be encouraged.

SEMESTER V

Theory Course - USPH501: Mathematical, Thermal and Statistical Physics

Learning outcomes: From this course, the students are expected to learn some mathematical techniques required to understand the physical phenomena at the undergraduate level and get exposure to important ideas of statistical mechanics.

The students are expected to be able to solve simple problems in probability, understand the concept of independent events and work with standard continuous distributions. The students will have idea of the functions of complex variables; solve nonhomogeneous differential equations and partial differential equations using simple methods. The units on statistical mechanics would introduce the students to the concept of microstates, Boltzmann distribution and statistical origins of entropy. It is also expected that the student will understand the difference between different statistics, classical as well as quantum.

Unit - I	**Probability**	(15 lect.)

Review of basic concepts, introduction, sample space, events, independent events, conditional probability, probability theorems, methods of counting (derivation of formulae not expected), random variables, continuous distributions (omit joint distributions), binomial distribution, the normal distribution, the Poisson distribution.

Ref: MB – 15.1-15.9

Expected to cover solved problems from each section and solve at least the following problems:

section 2: 1-5, 11-15, **section 3:** 1, 3, 4, 5, **section 4:** 1, 3, 5,13, 21, **section 5:** 1, 10, 13, **section 6:** 1 to 9, **section 8:** 1 and 3, **section 9:** 2, 3, 4, 9.

Unit -II	**Complex functions and differential equations**	(15 lect.)

1. Functions of complex variables: The exponential and trigonometric functions, hyperbolic functions, logarithms, complex roots and powers, inverse trigonometric and hyperbolic functions, some applications.

Ref.: MB: 2.11 to 2.16

Expected to cover all solved problems. In addition, solve the following problems:

section 2: 16 – 2, 3, 8, 9, 10.

2. Second-order nonhomogeneous equations with constant coefficients, partial differential equations, some important partial differential equations in physics, method of separation of variables.

Ref : CH :5.2.4, 5.3.1 to 5.3.4

Expected to cover all solved problems. In addition, solve the following problems:

5.17 a to e, 5.23, 5.26, 5.29 to 5.35.

Unit -III	**Statistical Thermodynamics**	(15 lect.)

Microstates and configurations, derivation of Boltzmann distribution, dominance of Boltzmann distribution, physical meaning of the Boltzmann distribution law, definition of , the canonical ensemble, relating Q to q for an ideal gas, translational partition function, equipartition theorem, energy, entropy

ER: 13.1 to 13.5, 14.1, 14.2, 14.4, 14.8, 15.1, 15.4

Unit -IV	**Classical and Quantum Statistics**	(15 lect.)

The probability of a distribution, The most probable distribution, Maxwell-Boltzmann statistics, Molecular speeds.

Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula, The

Planck radiation formula, Fermi-Dirac statistics, Comparison of results.

AB : 15.2 to 15.5, 16.1 to 16.6

References:

1.	MB: Mathematical Methods in the Physical sciences: Mary L. Boas Wiley India, 3rd ed.
2.	ER: Thermodynamics, Statistical Thermodynamics and Kinetics: T. Engel and P. Reid (Pearson).
3.	AB: Perspectives of Modern Physics: Arthur Beiser, (Mc Graw Hill International).
4.	CH: Introduction to Mathematical Methods: Charlie Harper (PHI Learning).
Additional References:	
1.	Mathematical Physics: A K Ghatak, Chua – 1995 Macmillian India Ltd.
2.	Mathematical Method of Physics: Riley, Hobson and Bence, Cambridge (Indian edition).
3.	Mathematical Physics: H. K. Das, S. Chand & Co.
4.	Mathematical Methods of Physics: Jon Mathews & R. L. Walker, W A Benjamin inc.
5.	A Treatise on heat: Saha and Srivastava (Indian press, Allahabad)
6.	Statistical Physics: F. Reif (Berkeley Physics Course, McGraw Hill)
7.	Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Science Publications).
8.	An Introduction to Thermal Physics: D. V. Schroeder (Pearson).
9.	PROBABILITY: Schaum's Outlines Series by S. Lipschutz and M. L. Lipson (Mc Graw Hill International).

Theory Course - USPH502: Solid State Physics

Learning Outcomes: On successful completion of this course students will be able to:

1. Understand the basics of crystallography, Electrical properties of metals, Band Theory of solids, demarcation among the types of materials, Semiconductor Physics and Superconductivity.
2. Understand the basic concepts of Fermi probability distribution function, Density of states, conduction in semiconductors and BCS theory of superconductivity.
3. Demonstrate quantitative problem solving skills in all the topics covered.

Unit - I	**Crystal Physics**	(15 lect.)

The crystalline state, Basic definitions of crystal lattice, basis vectors, unit cell, primitive and non-primitive cells, The fourteen Bravais lattices and the seven crystal systems, elements of symmetry, nomenclature of crystal directions and crystal planes, Miller Indices, spacing between the planes of the same Miller indices, examples of simple crystal structures, The reciprocal lattice and X-ray diffraction.

Ref: Elementary Solid State Physics-Principles and Applications: M. Ali Omar, Pearson Education, 2012 : (1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.6)

Unit -II	**Electrical properties of metals**	(15 lect.)

1. Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path
2. Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Heat capacity of the Electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Failure of Sommerfeld's free electron Theory
3. Thermionic Emission

Ref.: Solid State Physics: S. O. Pillai, New Age International. 6th Ed.

Chapter 6: II, III, IV, V, XIV, XV, XVI, XVII, XVIII, XX, XXXV, XXXI.

Unit -III	**Band Theory of Solids and Conduction in Semiconductors**	(15 lect.)

1. Band theory of solids, The Kronig- Penney model (Omit eq. 6.184 to 6.188), Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors.

   Ref.: Solid State Physics: S. O. Pillai, New Age International, 6th Ed.

   Chapter 6: XXXVI, XXXVII, XXXVIII, XXXIX, XXXX, XXXXI

2. Electrons and Holes in an Intrinsic Semiconductor, Conductivity of a Semiconductor, Carrier concentrations in an intrinsic semiconductor, Donor and Acceptor impurities, Charge densities in a semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, Hall Effect.

   Ref.: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.: 4.1 to 4.10.

Unit -IV	**Diode Theory and superconductivity**	(15 lect.)

1. Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance.

   Ref.: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.: 5.1 to 5.8

2. Superconductivity: Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS theory of superconductivity, Type I and Type II Superconductors, Vortex state.

   Ref.: Introduction to Solid State Physics-Charles Kittel, 7th Ed. John Wiley & Sons: Topics from Chapter 12.

Main References:

1.	Elementary Solid State Physics-Principles and Applications: M.Ali Omar, Pearson Education, 2012.
2.	Solid State Physics: S. O. Pillai, New Age International, 6th Ed.
3.	Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.
4.	Introduction to Solid State Physics - Charles Kittel, 7th Ed. John Wiley & Sons.
5.	Modern Physics and Solid State Physics: Problems and solutions New Age International.
Additional References:	
1.	Solid State Physics: A. J. Dekker, Prentice Hall.
2.	Electronic Properties of Materials: Rolf Hummel, 3rd Ed. Springer.
3.	Semiconductor Devices: Physics and Technology, 2nd Ed. John Wiley & Sons.
4.	Solid State Physics: Ashcroft & Mermin, Harcourt College Publisher.

Theory Course - USPH503: Atomic and Molecular Physics

Learning Outcome: Upon successful completion of this course, the student will understand

- the application of quantum mechanics in atomic physics
- the importance of electron spin, symmetric and antisymmetric wave functions and vector atom model
- Effect of magnetic field on atoms and its application
- Learn Molecular physics and its applications.
- This course will be useful to get an insight into spectroscopy.

Unit - I		(15 lect.)

1. Hydrogen atom: Schrödinger's equation for Hydrogen atom, Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part).

2. Electron spin: The Stern-Gerlach experiment, Pauli's Exclusion Principle Symmetric and Anti-symmetric wave functions.

Ref – Unit – I - B: 9.1 to 9.9, B: 10.1, 10.3. 2

Unit -II		(15 lect.)

1. Spin orbit coupling, Total angular momentum, Vector atom model, L-S and j-j coupling. Origin of spectral lines, Selection rules.
2. Effect of Magnetic field on atoms, the normal Zeeman effect and its explanation (Classical and Quantum), The Lande g - factor, Anomalous Zeeman effect.

Ref – Unit – II - B: 10.2, 10.6, 10.7, 10.8, 10.9. B : 11.1 and 11.2

Unit -III		(15 lect.)

1. Molecular spectra (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational-Rotational spectra. Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation, Intensity of vibrational-electronic spectra: The Franck-Condon principle.
2. Infrared spectrometer & Microwave spectrometer

. Ref – Unit – III - B: 14.1, 14.3, 14.5, 14.7

Unit -IV		(15 lect.)

1. Raman effect: Quantum Theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, symmetric top molecules, Asymmetric top molecules, Vibrational Raman spectra: Raman activity of vibrations, Experimental set up of Raman Effect.
2. Electron spin resonance: Introduction, Principle of ESR, ESR spectrometer
3. Nuclear magnetic resonance: Introduction, principle and NMR instrumentation.

Ref – Unit – IV - 1. BM: 6.11, 6.1.3. 2. BM: 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1. GA: 8.6.1 2. GA: 11.1,11.2and 11.3 3. GA: 10.1,10.2,10.3

References:

1.	B: Perspectives of Modern Physics : Arthur Beiser Page 8 of 18 McGraw Hill.
2.	BM: Fundamentals of Molecular Spectroscopy : C. N. Banwell & E. M. McCash (TMH).(4th Ed.)
3.	GA: Molecular structure and spectroscopy : G Aruldhas (2nd Ed) PHI learning Pvt Ltd.
4.	Atomic Physics (Modern Physics): S.N.Ghoshal. S.Chand Publication (for problems on atomic Physics).

Theory Course - USPH504: Electrodynamics

Learning outcomes:

On successful completion of this course students will be able to:

1) Understand the laws of electrodynamics and be able to perform calculations using them.
2) Understand Maxwell's electrodynamics and its relation to relativity
3) Understand how optical laws can be derived from electromagnetic principles.
4) Develop quantitative problem solving skills.

Unit - I	**Electrostatics**	(15 lect.)

1. Review of Coulomb & Gauss law, The divergence of **E**, Applications of Gauss' law, The curl of **E**. Introduction to potential, Comments on potential, The potential of a localized charge distribution. Poisson's equation and Laplace's equation. Solution and properties of 1D Laplace equation. Properties of 2D and 3D Laplace equation (without proof).

2. Boundary conditions and Uniqueness theorems, Conductors and Second Uniqueness theorem, The classic image problem- point charge and grounded infinite conducting plane and conducting sphere.

DG: 2.1.1 to 2.1.3, 2.2.2 to 2.2.4, 2.3.1 to 2.3.4
DG: 3.1.1 to 3.1.4, 3.1.5, 3.1.6, 3.2.1 to 3.2.4

Unit -II	**Electrostatics in Matter and Magnetostatics**	(15 lect.)

1. Dielectrics, Induced Dipoles, Alignment of polar molecules, Polarization, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant and relation between them, Energy in dielectric systems.

2. Review of Biot-Savart's law and Ampere's law, Straight-line currents, The Divergence and Curl of **B**, Applications of Ampere's Law in the case of a long straight wire and a long solenoid, Comparison of Magnetostatics and Electrostatics, Magnetic Vector Potential.

DG: 4.1.1 to 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.4.1, 4.4.3
DG: 5.2.1, 5.3.1 to 5.3.4, 5.4.1

Unit -III	**Magnetostatics in Matter and Electrodynamics**	(15 lect.)

1. Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability.

2. Energy in magnetic fields, Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions.

DG: 6.1.1, 6.1.4, 6.2.1, 6.2.2, 6.2.3, 6.3.1, 6.3.2, 6.4.1
DG: 7.2.4, 7.3.1 to 7.3.6

Unit -IV	**Electromagnetic Waves**	(15 lect.)

1. The continuity equation, Poynting's theorem

2. The wave equation for **E** and **B**, Monochromatic Plane waves, Energy and momentum in electromagnetic waves, Propagation in linear media, Reflection and transmission of EM waves at normal incidence, Reflection and transmission of EM waves at oblique incidence.

DG : 8.1.1, 8.1.2

DG : 9.2.1 to 9.2.3, 9.3.1 to 9.3.3

References	
1.	DG: Introduction to Electrodynamics, David J. Griffiths (3rd Ed) Prentice Hall of India.
Additional References	
1.	Introduction to Electrodynamics: A. Z. Capria and P. V. Panat, Narosa Publishing House.
2.	Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH).
3.	Foundations of Electromagnetic Theory: Reitz, Milford and Christy.
4.	Solutions to Introduction to Electrodynamics: David J. Griffiths (3rd Ed) Prentice Hall of India.

PRACTICALS - SEMESTER V

The T. Y. B. Sc. Syllabus integrates the regular practical work with a series of demonstration and skill experiments. During the teaching and examination of Physics laboratory work, simple modifications of experimental parameters may be attempted. Attention should be given to basic skills of experimentation which include:

i)	Understanding relevant concepts.
ii)	Planning of the experiments.
iii)	Layout and adjustments of the equipments.
iv)	Recording of observations and plotting of graphs.
v)	Calculation of results and estimation of possible errors in the observation of results.

i) Regular Physics Experiments: A minimum of **8** experiments from each of the course are to be performed and reported in the journal.

ii) Skill Experiments: All the skill experiments are compulsory and must be reported in the journal. Skills will be tested during the examination through viva or practical.

The certified journal must contain a minimum of **16** regular experiments (**8** from each group), **with all** Skill experiments in semester V. A separate index and certificate in journal is must for each semester course.

There will be TWO turns of **three hours each** for the examination of practical courses.

SEMESTER V	
PRACTICAL COURSE: USPHP05	
Sr. No.	**Name of the Experiment**
1	Determination of 'g' by Kater's pendulum
2	Surface tension of soap solution
3	Elastic constants of a rubber tube
4	Determination of dielectric constant
5	Logarithmic decrement
6	Searle's Goniometer
7	Determination of Rydberg's constant
8	Edser's 'A' pattern
9	Determination of wavelength by Step slit
10	Determination of e/m by Thomson's method
11	R. I. by total internal reflection
12	Velocity of sound in air using CRO
PRACTICAL COURSE: USPHP06	
Sr. No.	**Name of the Experiment**
1	Mutual inductance by BG.
2	Capacitance by parallel bridge
3	Hysteresis loop by CRO
4	L/C by Maxwell's bridge
5	Band gap energy of Ge diode
6	Design and study of transistorized astable multivibrator (BB)
7	Design and study of Wien bridge oscillator
8	Design and study of first order active low pass filter circuit (BB)
9	Design and study of first order active high pass filter circuit (BB)
10	Application of IC 555 timer as a ramp generator (BB)
11	LM 317 as constant current source
12	Counters Mod 2, 5, 10 (2 x 5, 5 x 2)

SKILL EXPERIMENTS	
Sr. No.	**Name of the Experiment**
1	Estimation of errors from actual experimental data
2	Soldering and testing of an astable multivibrator (Tr./IC555) circuit on PCB
3	Optical Leveling of Spectrometer
4	Schuster's method
5	Laser beam profile
6	Use of electronic balance: Find the density of a solid cylinder
7	Dual trace CRO: Phase shift measurement
8	C1/C2 by B G
9	Internal resistance of voltage and current source
10	Use of DMM to test diode, transistor and β factor

References:	
1.	Advanced course in Practical Physics: D. Chattopadhya, PC. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd.
2.	BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
3.	A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition).
4.	B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
5.	Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press.
6.	University Practical Physics: D C Tayal. Himalaya Publication.
7.	Advanced Practical Physics: Worsnop & Flint.

SEMESTER VI

Theory Course – USPH601: Classical Mechanics

Learning outcomes:

This course will introduce the students to different aspects of classical mechanics. They would understand the kinds of motions that can occur under a central potential and their applications to planetary orbits. The students should also appreciate the effect of moving coordinate system, rectilinear as well as rotating. The students are expected to learn the concepts needed for the important formalism of Lagrange's equations and derive the equations using D'Alembert's principle. They should also be able to solve simple examples using this formalism. The introduction to simple concepts from fluid mechanics and understanding of the dynamics of rigid bodies is also expected. Finally, they should appreciate the drastic effect of adding nonlinear corrections to usual problems of mechanics and nonlinear mechanics can help understand the irregularity we observe around us in nature.

Unit - I	**Central Force**	(15 lect.)
1. Motion under a central force, the central force inversely proportional to the square of the distance, Elliptic orbits, The Kepler problem. 2. Moving origin of coordinates, Rotating coordinate systems, Laws of motion on the rotating earth, The Foucault pendulum, Larmor's theorem. KRS: 3.13 - 3.15, 7.1 - 7.5.		
Unit -II	**Lagrange's equations**	(15 lect.)
1. D'Alembert's principle, Constraints, Examples of holonomic constraints, examples of nonholonomic constraints, degrees of freedom and generalized coordinates, virtual displacement, virtual work, D'Alembert's principle, illustrative problems. 2. Lagrange's equations (using D'Alembert's principle), properties of Lagrange's equations, illustrative problems, canonical momentum, cyclic or ignorable coordinates. PVP: 4.2 to 4.9, 5.2 to 5.4, 7.2, 7.3.		

Unit -III	**Fluid Motion and Rigid body rotation**	(15 lect.)
1. Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. 2. Rigid dynamics: introduction, degrees of freedom, rotation about an axis: orthogonal matrix, Euler's theorem, Eulerian angles, inertia tensor, angular momentum of rigid body, Euler's equation of motion of rigid body, free motion of rigid body, motion of symmetric top (without notation). KRS : 8.6 to 8.9 PVP: 16.1 to 16.10		
Unit -IV	**Non Linear Mechanics**	(15 lect.)
1. Nonlinear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation. 2. Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behavior (Logistic map). BO: 11.1, 11.3 to 11.5		

References	
1.	PVP: Classical Mechanics, P. V. Panat (Narosa).
2.	KRS: Mechanics : Keith R. Symon, (Addision Wesely) 3rd Ed.
3.	BO: Classical Mechanics- a Modern Perspective: V. D. Barger and M. G. Olsson. (Mc Graw Hill International 1995 Ed.)
Additional References	
1.	Classical Mechanics: Herbert Goldstein (Narosa 2nd Ed.).
2.	An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow Tata Mc Graw Hill (Indian Ed. 2007).
3.	Chaotic Dynamics- an introduction: Baker and Gollub (Cambridge Univ. Press).
4.	Classical Mechanics: J. C. Upadhyaya (Himalaya Publishing House).

Theory Course – USPH602: Electronics

Learning Outcome:

On successful completion of this course students will be able to:

1. Understand the basics of semiconductor devices and their applications.
2. Understand the basic concepts of operational amplifier: its prototype and applications as instrumentation amplifier, active filters, comparators and waveform generation.
3. Understand the basic concepts of timing pulse generation and regulated power supplies
4. Understand the basic electronic circuits for universal logic building blocks and basic concepts of digital communication.
5. Develop quantitative problem solving skills in all the topics covered.

Unit - I		(15 lect.)
1. Field effect transistors: JFET: Basic ideas, Drain curve, The transconductance curve, Biasing in the ohmic region and the active region, Transconductance, JFET common source amplifier, JFET analog switch, multiplexer, voltage controlled resistor, Current sourcing. 2. MOSFET: Depletion and enhancement mode, MOSFET operation and characteristics, digital switching. 3. SCR – construction, static characteristics, Analysis of the operation of SCR, Gate Triggering Characteristics, Variable half wave rectifier and Variable full wave rectifier, Current ratings of SCR. 4. UJT: Construction, Operation, characteristics and application as a relaxation oscillator. 1. MB: 13.1 to 13.9 2. MB: 14.1, 14.2, 14.4, 14.6. 3. AM: 28.1, 28.5		
Unit -II		(15 lect.)
1. Differential Amplifier using transistor: The Differential Amplifier, DC and AC analysis of a differential amplifier, Input characteristic-effect of input bias, offset current and input offset voltage on output, common mode gain, CMRR.		

2. Op Amp Applications: Log amplifier, Instrumentation amplifiers, Voltage controlled current sources (grounded load), First order Active filters, Astable using OP AMP, square wave and triangular wave generator using OP AMP, Wein-bridge oscillator using OP AMP, Comparators with Hysteresis, Window Comparator.

1. MB: 17.1 to 17.5
2. MB: 20.5, 20.8, 21.4, 22.2, 22.3, 22.7, 22.8, 23.

Unit -III		(15 lect.)

1. Transistor Multivibrators: Astable, Monostable and Bistable Multivibrators, Schmitt trigger.

2. 555 Timer: Review Block diagram, Monostable and Astable operation Voltage Controlled Oscillator, Pulse Width modulator, Pulse Position Modulator, Triggered linear ramp generator.

3. Regulated DC power supply: Supply characteristics, series voltage regulator, Short circuit protection (current limit and fold back) Monolithic linear IC voltage Regulators. (LM 78XX, LM 79XX, LM 317, LM337).

1. AM: 18.11
2. KVR: 14.5.2.1, 14.5.2.5, 14.5.2.6, 14.5.4.1
3. MB: 23.8, 23.9
4. MB: 24.1, 24.3, 24.4

Unit -IV		(15 lect.)

1. Logic families: Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, MOS inverters, CMOS NAND and NOR gates, CMOS characteristics.

2. Digital Communication Techniques: Digital Transmission of Data, Benefits of Digital Communication, Disadvantages of Digital Communication, Parallel and Serial Transmission, Pulse Modulation, Comparing Pulse-Modulation Methods (PAM, PWM, PPM), Pulse-Code Modulation.

1. ML: 6.2, 6.4, 6.6, 6.7, 7.2 to 7.4.
2. LF: 7.1, 7.2, 7.4

References	
1.	MB: Electronic Principles, Malvino & Bates -7th Ed TMH Publication.
2.	AM: Electronic Devices and Circuits, Allen Mottershead -PHI Publication.
3.	KVR: Functional Electronics, K.V. Ramanan-TMH Publication.
4.	ML: Digital Principles and Applications, Malvino and Leach (4th Ed)(TMH).
5.	LF: Communication Electronics: Principles and applications, Louis E Frenzel 4th edition TMH Publications.

Theory Course – USPH603: Nuclear Physics

Objectives:

The course is built on exploring the fundamentals of nuclear matter as well as considering some of the important applications of nuclear physics. Topics include decay modes – (alpha, beta & gamma decay), nuclear models (liquid drop model, introduction to shell model), Applications of Nuclear Physics in the field of particle accelerators and energy generation, nuclear forces and elementary particles. The lecture course will be integrated with problem solving.

Learning Outcomes:

- Upon successful completion of this course, the student will be able to understand
  the fundamental principles and concepts governing classical nuclear and particle physics and have a knowledge of their applications interactions of ionizing radiation with matter the key techniques for particle accelerators the physical processes involved in nuclear power generation.
- Knowledge on elementary particles will help students to understand the fundamental constituents of matter and lay foundation for the understanding of unsolved questions about dark matter, antimatter and other research oriented topics.

Unit - I	**Alpha & Beta Decay**	(15 lect.)

1. Alpha decay: Velocity, energy, and Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Range of alpha particles, alpha particle spectrum, Fine structure, long range alpha particles, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger-Nuttal law).

2. Beta decay: Introduction, Velocity and energy of beta particles, Energy levels and decay schemes, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Energetics of beta decay.

1. IK: 13. 1, 13.2, 13.5, SBP: 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3
2. IK: 14.1, 14.7, SBP: 4. III. 1, 4. III. 2, 4. III. 3, 4. III. 5, SNG : 5.5.

Unit -II	**Gamma Decay & Nuclear Models**	(15 lect.)

1. Gamma decay: Introduction, selection rules, Internal conversion, nuclear isomerism, Mossbauer effect.

2. Nuclear Models: Liquid drop model, Weizsacker's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Shell model (Qualitative), Magic numbers in the nucleus.

1. SBP: 4. IV. 1, 4. IV.2, 4. IV. 3, 4. IV. 4, 9.4
2. SBP: 5.1, 5.3, 5.4, 5.5. AB: 11.6-pages (460,461).

Unit -III	**Nuclear Energy & Particle Accelerators**	(15 lect.)

1. Nuclear energy: Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Nuclear release in fission, Nature of fission fragments, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear power and breeder reactors, Natural fusion Possibility of controlled fusion.

2. Particle Accelerators: Van de Graaff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider.

1. SBP: 6.1, 6.3 to 6.9, 9.6, 9.7, 8.1,8.2,8.3
2. SBP: 1.I.4 (i), 1.I.4 (ii), 1.I.4 (iii), 1.I.4 (iv), 6.9, AB: 13.3

Unit -IV	**Nuclear force & Elementary particles**	(15 lect.)

1. Nuclear force: Introduction, Deuteron problem, Meson theory of Nuclear Force- A qualitative discussion.

2. Elementary particles: Introduction, Classification of elementary particles, Particle interactions, Conservation laws (linear &angular momentum, energy, charge, baryon number & lepton number), particles and antiparticles (Electrons and positrons, Protons and anti-protons, Neutrons and anti-neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative).

1. SBP: 8.6
2. DCT: 18.1, 18.2,18.3, 18.4 , 18.5 to 18.9 AB: 13.5

References	
1.	AB: Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6th Ed.) (TMH).
2.	SBP: Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.).
3.	IK: Nuclear Physics, Irving Kaplan (2nd Ed.) (Addison Wesley).
4.	SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)
5.	DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5th ed.
Additional References	
1.	Modern Physics: Kenneth Krane (2nd Ed.), John Wiley & Sons.
2.	Atomic & Nuclear Physics: N Subrahmanyam, Brij Lal. (Revised by Jivan Seshan.) S. Chand.
3.	Atomic & Nuclear Physics: A B Gupta & Dipak Ghosh Books & Allied (P) Ltd.
4	Introduction to Elementary Particles: David Griffith, Second Revised Edition, Wiley-VCH.

Theory Course – USPH604: Special Theory of Relativity

Learning outcomes:

This course introduces students to the essence of special relativity which revolutionized the concept of physics in the last century by unifying space and time, mass and energy, electricity and magnetism. This course also gives a very brief introduction of general relativity. After the completion of the course the student should be able to

1. Understand the significance of Michelson Morley experiment and failure of the existing theories to explain the null result
2. Understand the importance of postulates of special relativity, Lorentz transformation equations and how it changed the way we look at space and time, Absolutism and relativity, Common sense versus Einstein concept of Space and time.
3. Understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, Energy, Charge and current density, electric and magnetic fields.
4. Solve problems based on length contraction, time dilation, velocity addition, Doppler effect, mass energy relation and resolve paradoxes in relativity like twin paradox etc.

Unit - I		(15 lect.)

Introduction to Special theory of relativity:
Inertial and Non-inertial frames of reference, Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment (omit derivation part), Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and Ether drag hypothesis (conceptual), Stellar aberration, Attempt to modify electrodynamics.

Relativistic Kinematics - I: Postulates of the special theory of relativity, Simultaneity, Derivation of Lorentz transformation equations. Some consequences of the Lorentz transformation equations: length contraction, time dilation and meson experiment, The observer in relativity.

RR: 1.1 to 1.9, 2.1 to 2.5

Unit -II		(15 lect.)
Relativistic Kinematics - II: The relativistic addition of velocities, acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity. **The Geometric Representation of Space-Time:** Space-Time Diagrams, Simultaneity, Length contraction and Time dilation, The time order and space separation of events, The twin paradox. RR: 2.6 to 2.8, Supplementary topics A1, A2, A3, B1, B2, B3.		
Unit -III		(15 lect.)
Relativistic Dynamics: Mechanics and Relativity, The need to redefine momentum, Relativistic momentum, Alternative views of mass in relativity, The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, The transformation properties of momentum, energy and mass. RR: 3.1 to 3.7		
Unit -IV		(15 lect.)
Relativity and Electromagnetism: Introduction, The interdependence of Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, The invariance of Maxwell's equations. The principle of equivalence and general relativity, Gravitational red shift. RR: 4.1 to 4.7. Supplementary topic C1, C2, C3, C4. **Note: (A good number of problems to be solved from Resnick).**		

References	
1.	RR: Introduction to Special Relativity: Robert Resnick (Wiley Student Edition).
2.	Special theory of Relativity: A. P. French.
3.	Very Special Relativity – An illustrated guide: by Sander Bais - Amsterdam University Press.
4.	Chapter 1: Concepts of Modern Physics by Arthur Beiser.
5.	Chapter 2: Modern Physics by Kenneth Krane.

SEMESTER VI

The T. Y. B. Sc. Syllabus integrates the regular practical work with a series of demonstration and skill experiments. During the teaching and examination of Physics laboratory work, simple modifications of experimental parameters may be attempted. Attention should be given to basic skills of experimentation which include:

i)	Understanding relevant concepts.
ii)	Planning of the experiments.
iii)	Layout and adjustments of the equipments.
iv)	Recording of observations and plotting of graphs.
v)	Calculation of results and estimation of possible errors in the observation of results.

i) Regular Physics Experiments: A minimum of **8** experiments from each of the practical course are to be performed and reported in the journal.

ii) Demonstration Experiments: The demonstration experiments are to be performed by the teacher in the laboratory and students should be encouraged to participate and take observation wherever possible.

Demonstration experiments are designed to bring about interest and excitement in Physics. Students are required to enter details of these 'demonstration' experiments in their journal.

The certified journal must contain a minimum of **16** regular experiments (**8** from each practical course), with minimum **6** demonstration experiments in semester VI. A separate index and certificate in journal is must for each course in each semester.

There will be TWO turns of three hours each for the examination of practical courses.

SEMESTER VI	
PRACTICAL COURSE: USPHP07	
Sr. No.	**Name of the Experiment**
1	Surface tension of mercury by Quincke's method
2	Thermal conductivity by Lee's method
3	Study of JFET characteristics
4	JFET as a common source amplifier
5	JFET as switch (series and shunt)
6	UJT characteristics and relaxation oscillator
7	Study of Pulse width modulation (BB)
8	Study of Pulse position modulation (BB)
9	Determination of h/e by photocell
10	R. P. of Prism
11	Double refraction
12	Lloyd's single mirror: determination of wavelength
PRACTICAL COURSE: USPHP08	
Sr. No.	**Name of the Experiment**
1	Determination of M/C by using BG
2	Self-inductance by Anderson's bridge
3	Hall effect
4	Solar cell characteristics and determination of V_{oc}, I_{sc} and P_{max}
5	Design and study of transistorized monostable multivibrator (BB)
6	Design and study of transistorized bistable multivibrator (BB)
7	Application of Op-Amp as a window comparator
8	Application of Op-Amp as a Log amplifier
9	Application of IC 555 as a voltage to frequency converter (BB)
10	Application of IC 555 as a voltage to time converter (BB)
11	LM-317 as variable voltage source
12	Shift register

DEMONSTRATION EXPERIMENTS	
Sr. No.	**Name of the Experiment**
1	Open CRO, Power Supply, and Signal Generator: block diagrams
2	Data sheets: Diodes, Transistor, Op-amp & Optoelectronic devices
3	Zeeman Effect
4	Michelson's interferometer
5	Constant deviation spectrometer (CDS)
6	Digital storage oscilloscope (DSO)
7	Determination of Op-Amp parameters (offset voltage, slew rate, input impedance, output impedance, A_{CM})
8	Transformer (theory, construction and working), types of transformers and energy losses associated with them.
9	Use of LCR meter
10	Lux meter / Flux meter

References:

1.	Advanced course in Practical Physics: D. Chattopadhya, PC. Rakshit & B. Saha (8^{th} Edition) Book & Allied (P) Ltd.
2.	BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
3.	A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4^{th} edition).
4.	B Sc. Practical Physics: C. L. Arora (1^{st} Edition) – 2001 S. Chand & Co.
5.	Practical Physics: C. L. Squires – (3^{rd} Edition) Cambridge Univ. Press.
6.	University Practical Physics: D C Tayal, Himalaya Publication.
7.	Advanced Practical Physics: Worsnop & Flint.

Student Id	NAME_LFM	Course Name	ROLL NO	Subject Combination
2946843	SAMSON ABIN SAMSON	TYBSC	30	CHEMISTRY (SINGLE MAJOR)
2946848	KHAN AASMA MOHAMMED YUSUF	TYBSC	15	CHEMISTRY (SINGLE MAJOR)
2946849	SHAH SHAFA NASIR	TYBSC	32	CHEMISTRY (SINGLE MAJOR)
2946851	KUMAR RONIT KUMAR	TYBSC	20	CHEMISTRY (SINGLE MAJOR)
2946853	IKH IRAM SABA MOHAMMED MANSOOR AL	TYBSC	35	CHEMISTRY (SINGLE MAJOR)
2946855	KHAN FARDEEN FIROZ	TYBSC	16	CHEMISTRY (SINGLE MAJOR)
2946856	HAIKH MUSHARRAF ALI MOHAMMED HAMI	TYBSC	38	CHEMISTRY (SINGLE MAJOR)
2946858	ANSARI MOHAMAD ANAS IRSHAD AHMED	TYBSC	11	CHEMISTRY (SINGLE MAJOR)
2946859	ROMAN NITIN PRAKASH	TYBSC	29	CHEMISTRY (SINGLE MAJOR)
2946861	SHAIKH MNTASA BANOO NIZAM AHAMAD	TYBSC	24	CHEMISTRY (SINGLE MAJOR)
2946862	HAIKH KEHKASHAN PARVEEN MOHD MUQIN	TYBSC	36	CHEMISTRY (SINGLE MAJOR)
2946863	PATEL AFRIN ADAM	TYBSC	25	CHEMISTRY (SINGLE MAJOR)
2946864	KHAN SANA SUBHAN	TYBSC	45	CHEMISTRY (SINGLE MAJOR)
2946865	SHAIKH MOHD KAIF MOHDMUKIM	TYBSC	37	CHEMISTRY (SINGLE MAJOR)
2946866	LIMBASIA MEET ALPESHBHAI	TYBSC	21	CHEMISTRY (SINGLE MAJOR)
2946868	KHAN SABA ASLAM	TYBSC	18	CHEMISTRY (SINGLE MAJOR)
2946869	MAHADIK PRATIKESH DINESH	TYBSC	22	CHEMISTRY (SINGLE MAJOR)
2946870	MEMON SUFIYAN RAFIQUE	TYBSC	23	CHEMISTRY (SINGLE MAJOR)
2946873	SHAIKH ASIF ZAKIR	TYBSC	33	CHEMISTRY (SINGLE MAJOR)
2946874	SAYYED UBAID MEHBOOB	TYBSC	31	CHEMISTRY (SINGLE MAJOR)
2946875	SHAIKH ABIDA KHATOON JALALUDDIN	TYBSC	1	PHYSICS (SINGLE MAJOR)
2946876	MOMIN JUVERIYA MOHD ASHFAQUE	TYBSC	12	CHEMISTRY (SINGLE MAJOR)
2946878	SHAIKH SAHAD RIYAZ	TYBSC	28	CHEMISTRY (SINGLE MAJOR)
2946879	SINGH HARSH ANAND	TYBSC	43	CHEMISTRY (SINGLE MAJOR)
2946884	KHAN MOHAMMED KASHIF MERAJ AHMED	TYBSC	17	CHEMISTRY (SINGLE MAJOR)
2946885	KHAN AADIL SHAHABUDDIN	TYBSC	14	CHEMISTRY (SINGLE MAJOR)
2946887	SHAIKH SUFIYAN MAZHARUL HUQ	TYBSC	40	CHEMISTRY (SINGLE MAJOR)

2946889	KHAN ZAYED ANWAR	TYBSC	19	CHEMISTRY (SINGLE MAJOR)
2946890	KAZI MOHD SUBHAN WAZID	TYBSC	13	CHEMISTRY (SINGLE MAJOR)
2946891	SHAIKH MOHD ADEEL MOHD MOINUDDIN	TYBSC	47	CHEMISTRY (SINGLE MAJOR)
2946892	SHAIKH AYESHA RIYAZ	TYBSC	34	CHEMISTRY (SINGLE MAJOR)
2946893	DIVEKAR SAURABH SANDIP	TYBSC	2	PHYSICS (SINGLE MAJOR)
2946896	PATIL SAYLAI DINESH	TYBSC	27	CHEMISTRY (SINGLE MAJOR)
2946898	SIDDIQUI SHAHEEN MUZAFFAR	TYBSC	42	CHEMISTRY (SINGLE MAJOR)
2946899	SHAIKH TARANNUM FIRDOUS ABDUL RAFIQ	TYBSC	46	CHEMISTRY (SINGLE MAJOR)
2946900	PATIL BHUSHAN GANPAT	TYBSC	26	CHEMISTRY (SINGLE MAJOR)
2946906	SYED RAZAN ANWAR	TYBSC	44	CHEMISTRY (SINGLE MAJOR)
2946907	SHAIKH SALIM DILBAHAR	TYBSC	39	CHEMISTRY (SINGLE MAJOR)
2946910	SHIRKE RUTIK RAVINDRA	TYBSC	41	CHEMISTRY (SINGLE MAJOR)