Study & Evaluation Scheme

of

Bachelor of Science (Hons) (Specialization in Physics/Chemistry/Maths)

[Applicable for 2018-21]

Version 2018

[As per CBCS guidelines given by UGC]

Approved in BOS	Approved in BOF	Approved in Academic Council
13-06-2018	18-06-2018	13-07-2018 Vide Agenda No. 1.7.3

Quantum University, Roorkee
22 KM Milestone, Dehradun-Roorkee Highway, Roorkee (Uttarakhand)
Website: www.quantumuniversity.edu.in

Quantum University, Roorkee

Study & Evaluation Scheme

Study Summary

Name of the Faculty	Faculty of Graduate Studies
Name of the School	Quantum School of Graduate Studies
Name of the Department	Department of Sciences
Program Name	Bachelor of Science (Hons) (Specialization in Physics/Chemistry/Maths)
Duration	3 Years
Medium	English

Evaluation Scheme

Type of Papers	**Internal Evaluation (%)**	**End Semester Evaluation (%)**	**Total (%)**
Theory	40	60	100
Practical/ Dissertations/Project Report/ Viva-Voce	40	60	100
Internal Evaluation Components (Theory Papers)			
Sessional Examination I	50 Marks		
Sessional Examination II	50 Marks		
Assignment –I	25 Marks		
Assignment-II	25 Marks		
Attendance	50 Marks		
Internal Evaluation Components (Practical Papers)			
Quiz One	25 Marks		
Quiz Two	25 Marks		
Quiz Three	25 Marks		
Lab Records/ Mini Project	75 Marks		
Attendance	50 Marks		
End Semester Evaluation (Practical Papers)			
ESE Quiz	30 Marks		
ESE Practical Examination	50 Marks		
Viva- Voce	20 Marks		

Structure of Question Paper (ESE Theory Paper)

The question paper will consist of 5 questions, one from each unit. Student has to Attempt all questions. All questions carry 20 marks each. Parts a) and b) of question Q1 to Q5 will be compulsory and each part carries 2 marks. Parts c), d) and e) of Q1 to Q5 Carry 8 marks each and the student may attempt any 2 parts.

Important Note:

1. The purpose of examination should be to assess the Course Outcomes (CO) that will ultimately lead to attainment of Programme Outcomes (POs). The following aspects of learning planned for specific course: Remember, Understand, Apply, Analyze, Evaluate & Create (reference to Bloom's Taxonomy). The standard of question paper will be based on mapped BL level complexity of the unit of the syllabus, which is the basis of CO attainment model adopted in the university.

2. There shall be continuous evaluation of the student and there will be a provision of real time reporting on QUMS. All the assignments will evaluated through module available on ERP for time and access management of the class.

Program Structure – Bachelor of Science (Hons) (Specialization in Physics/Chemistry/Maths)

Introduction

The Bachelor of Science (Hons) courses offered in the undergraduate program at Quantum University, Roorkee form part of a comprehensive program that will enable the students to understand the basic laws of nature and develop necessary skills to apply them to any desired area or discipline. The program is planned as a student centric collaborative learning. Students get trained for a career in basic sciences or any related applied science or technology.

The Bachelor of Science (Hons) subjects are designed in such a way that students grasp all the knowledge related to science. Towards enhancing higher study, employability and entrepreneurial ability of the graduates the Quantum University increase the practical content in the courses wherever necessary. The total number of credit hours in 6 semesters will range from 139 to 148 for all the BSc(H) programs.

In order to harness regional specialties and to meet region-specific needs the Quantum University modify the content of syllabus as per the regional demands and needs.

General Pattern

The courses offered during the first year (Semesters I to II) are meant as basic and introductory courses in Chemistry, Mathematics, Physics and Skill Enhancing. These are common and mandatory for all students. They include six theory courses and four lab courses from each stream. These courses are inculcated to give a flavor of the various subjects and analyses to prepare the students for advanced courses in later years of study. In addition, there will be Interdisciplinary Courses for computational skills communication skills and environmental studies.
In the second and third years (Semesters III-VI), students have the freedom to choose advanced courses (particularly in final year) based on their interest and inclination. The courses offered in the first years would help them to make an informed judgment to determine their real interest and their aptitude for a given subject.

Specialization in Physics

The courses offered specialization in Physics at Quantum University, Roorkee form part of a comprehensive program at the level of a Bachelor's degree. The specialization in Physics program aims to enable students to understand the basic laws of nature and develop the necessary skills and tools to apply this understanding to other areas and disciplines. Here students are prepared for careers in basic physics as well as in related applied sciences or technology.

The list of courses offered from each discipline contained contents of syllabus (unit wise) with lists of reference books is given below. Other relevant details like objectives, course outcome, topic in detail, pattern of assessment, additional books for study and reference etc. will be prepared in the form of course file by the faculty and communicated to the students well in advance before start of each semester.

The courses offered in specialization in Physics program are structured in following levels-

Courses in I-II Semesters:

The first level spans courses offered during the first two semesters of the Bachelor of Science(Hons) Program. These courses are common and mandatory for all students. Based on their interests, the students specialize after completing the fourth semester. For this reason, the first level courses are designed to cover the basic concepts in physics along with some skill Enhancement courses in a very comprehensive

manner, since they could be the only physics courses taken by students specializing in other disciplines. These courses are meant to give the various approaches and analyses in Physics as well as to prepare them for advanced courses in later years of study. Physics courses in the first four semesters offer all students an exposure to both the rigor and breadth of physics, concentrating mainly on mechanics, waves and optics, electricity and magnetism, and quantum physics. There are Laboratory Courses that expose them to key experiments and teach them skills in handling basic equipment. In addition, there are Interdisciplinary Courses offered during this period: Mathematical Methods that provides the basic mathematical tools needed for a program in science, and Thermodynamics that provides an introduction to the concepts needed for the further study of physics and chemistry.

Courses in Semesters V-VI

The courses at the second level of the program are designed for students who have chosen to specialize primarily in physics. These are in-depth courses with a strong emphasis on developing problem-solving skills. The basic requirements for graduation during semesters V-VI, consist of 4 courses of 4 credits each. These are core courses meant for detailed and in-depth study covering all the basic areas of Physics. A student planning a career in Physics is expected to take all of them. These include Mathematical Physics-II, Advanced Electromagnetic Theory, Solid State Physics with open elective subjects Digital Systems and Its Applications, Applications of Quantum Mechanics, Astronomy and Astrophysics, Nuclear and Particle Physics, Mathematical Physics-III, Statistical Mechanics, Analog Systems and its Applications, Classical Dynamics, Physics of Earth, Applied Optics. Four Laboratory courses are offered, two in each semester, which will train students in advanced-level experiments and the use of modern equipment. The courses at this level are designed to train students to enter into a career as experimental or theoretical physicists. For this purpose, students are encouraged to follow their own inclinations and can take any combination of basic theoretical courses including current research topics, as well as advanced laboratory courses, along with courses like electronics and experimental methods.

Interdisciplinary Courses

The pattern of course work followed at Quantum University, Roorkee permits students specializing in other disciplines or areas, also to take courses from Physics. The various courses like; Mathematical Methods, Nonlinear Dynamics, Fluid Dynamics, Nanoscale Physics and Material Science are offered such that students interested in other disciplines also benefit from them. Similarly, a student interested in a career in Physics and interdisciplinary areas related to Physics, can take courses from other disciplines. Some such courses are Neurobiology, Genetics, Biophysics etc from Biology; Statistical Thermodynamics, Symmetry and Group Theory, Quantum Chemistry etc from Chemistry; and Differential Geometry, Statistics, Complex Analysis etc from Mathematics. During Semesters III and IV, students have to take at least one course from another discipline.

Specialization in Chemistry

The courses offered in specialization in Chemistry at Quantum University, Roorkee form part of a comprehensive program at the level of a Bachelor's degree. The specialization in Chemistry program aims to enable students to understand the basic laws of nature and develop the necessary skills and tools to apply this understanding to other areas and disciplines. Here students are prepared for careers in basic physics as well as in related applied sciences or technology.

The list of courses offered from each discipline contained contents of syllabus (unit wise) with lists of reference books is given below. Other relevant details like objectives, course outcome, topic in detail, pattern of assessment, additional books for study and reference etc. will be prepared in the form of course file by the faculty and communicated to the students well in advance before start of each semester.

The courses offered in specialization in Chemistry program are structured in following levels-

Courses in I-II Semesters:

The first level spans courses offered during the first two semesters of the Bachelor of Science(Hons) Program. These courses are common and mandatory for all students. Based on their interests, the students specialize after completing the fourth semester. For this reason, the first level courses are designed to cover the basic concepts in physics along with some skill Enhancement courses in a very comprehensive manner, since they could be the only physics courses taken by students specializing in other disciplines. These courses are meant to give the various approaches and analyses in Chemistry as well as to prepare them for advanced courses in later years of study. Chemistry courses in the first four semesters offer all students an exposure to both the rigour and breadth of Chemistry, concentrating mainly on Atomic molecules Solid state chemistry, Thermodynamics and itsapplications, and s &p block elements. There are Laboratory Courses that expose them to key experiments and teach them skills in handling basic equipment. In addition, there are Interdisciplinary Courses offered during this period: Mathematical Methods that provides the basic mathematical tools needed for a program in science, and Thermodynamics that provides an introduction to the concepts needed for the further study of physics and chemistry.

Courses in Semesters V-VI

The courses at the second level of the program are designed for students who have chosen to specialize primarily in chemistry. These are in-depth courses with a strong emphasis on developing problem-solving skills. The basic requirements for graduation during semesters V-VI, consist of 4 courses of 4 credits each. These are core courses meant for detailed and in-depth study covering all the basic areas of Physics. A student planning a career in chemistry is expected to take all of them. These include Organometallic chemistry, Chemical Kinetics, Instrumental methods of chemical analysis with open elective subjects Green Chemistry , Biochemistry,Research Methodology for chemistry, Chemistry of Molecules, Thermodynamics and its applications. Four Laboratory courses are offered, two in each semester, which will train students in advanced-level experiments and the use of modern equipment. The courses at this level are designed to train students to enter into a career as experimental or theoretical Chemistry. For this purpose, students are encouraged to follow their own inclinations and can take any combination of basic theoretical courses including current research topics, as well as advanced laboratory courses, along with courses like electronics and experimental methods.

Interdisciplinary Courses

The pattern of course work followed at Quantum University, Roorkee permits students specializing in other disciplines or areas, also to take courses from Chemistry. The various courses like; Instrumental Methods, Nonlinear Green Chemistry, Environmental chemistry, molecules of Life and Material Science are offered such that students interested in other disciplines also benefit from them. Similarly, a student interested in a career in Chemistry and interdisciplinary areas related to Chemistry, can take courses from other disciplines. Some such courses are Biochemistry, Genetics, etc from Biology; Statistical Thermodynamics, Symmetry and Group Theory, Quantum Chemistry etc from Chemistry; and Differential Geometry, Statistics, Complex Analysis etc from Mathematics. During Semesters III and IV, students have to take at least one course from another discipline.

Specialization in Mathematics

The courses offered in specialization in Mathematics at Quantum University, Roorkee form part of a comprehensive program at the level of a Bachelor's degree. The specialization in Mathematics program aims to enable students to understand the basic laws of nature and develop the necessary skills and tools to apply this understanding to other areas and disciplines. Here students are prepared for careers in basic physics as well as in related applied sciences or technology.

The list of courses offered from each discipline contained contents of syllabus (unit wise) with lists of reference books is given below. Other relevant details like objectives, course outcome, topic in detail, pattern of assessment, additional books for study and reference etc. will be prepared in the form of course file by the faculty and communicated to the students well in advance before start of each semester.

The courses offered in specialization in Mathematics program are structured in following levels-

Courses in I-II Semesters:

The first level spans courses offered during the first two semesters of the Bachelor of Science(Hons) Program. These courses are common and mandatory for all students. Based on their interests, the students specialize after completing the fourth semester. For this reason, the first level courses are designed to cover the basic concepts in physics along with some skill Enhancement courses in a very comprehensive manner, since they could be the only physics courses taken by students specializing in other disciplines. These coursesare meant to give the various approaches and analyses in Physics as well as to prepare them for advanced courses in later years of study. Mathematics courses in the first four semesters offer all students an exposure to both the rigor and breadth of physics, concentrating mainly on mechanics, waves and optics, electricity and magnetism, and quantum physics. There are Laboratory Courses that expose them to key experiments and teach them skills in handling basic equipment. In addition, there are Interdisciplinary Courses offered during this period: Mathematical Methods that provides the basic mathematical tools needed for a program in science, and Thermodynamics that provides an introduction to the concepts needed for the further study of physics and chemistry.

Courses in Semesters V-VI

The courses at the second level of the program are designed for students who have chosen to specialize primarily in physics. These are in-depth courses with a strong emphasis on developing problem-solving skills. The basic requirements for graduation during semesters V-VI, consist of 4 courses of 4 credits each. These are core courses meant for detailed and in-depth study covering all the basic areas of Mathematics. A student planning a career in Mathematics is expected to take all of them. These include Linear Algebra, Linear Programming Problems, Integral Transforms, Complex Analysis with open elective subjects Discrete Mathematics, Differential Geometry, Scientific Computing Using Matlab, Metric Space, Advance Mechanics, Number Theory andThe Theory of Rings etc.

Interdisciplinary Courses

The pattern of course work followed at Quantum University, Roorkee permits students specializing in other disciplines or areas, also to take courses from Mathematics. The various courses like; Numerical Analysis, Abstract Algebra, Statistical Techniques, Differential Equationsand Solid Geometry and Vector Calculusare offered such that students interested in other disciplines also benefit from them. Similarly, a student interested in a career in Mathematics and interdisciplinary areas related to Mathematics, can take courses from other disciplines. During Semesters III and IV, students have to take at least one course from another discipline.

The details of curriculum of Bachelor of Sciences (Hons) is as follows-

Curriculum (18-21) Version 2018

Quantum School of Graduate Studies

Bachelor of Science (Hons)

Specialization in Physics PC : 03-3-04

Specialization in Chemistry PC :03-3-06

Specialization in Mathematics PC: 03-3-05

Scheme & Syllabus

BREAKUP OF COURSES

Sr. No	CATEGORY	CREDITS
1	Foundation Core (FC)	9
2	Program Core (PC)	89 / 86**
3	Program Electives (PE)	16
4	Open Electives (OE)	09
5	Projects (PT)	05
6	Seminar (SM)	02
7	Internship	NA
8	Value Added Programs (VAP)	9
9	General Proficiency (GP)	5
10	Disaster Management	2*
	TOTAL NO. OF CREDITS (Without Minor) FOR BACHELOR OF SCIENCE (HONS) Specialization in Physics/Mathematics / **Specialization in Chemistry	144 / 141**

*Non-CGPA Audit Course

DOMAIN-WISE BREAKUP OF CATGEORY

	Foundation core	Program core	Program Elective	Sub total	%
Sciences	2	#89/86**	16	114/111**	79.2/78.7**
Humanities	3			3	2.0/2.1**
Management				-	0
Engineering	4			4	2.8/2.8**
Open Elective				9	6.3/6.4**
VAP				9	6.3/6.4**
GP				5	3.4/3.5**
Disaster Management*				2*	0.0
Grand Total	**9**	**89/86****	**16**	**144/141****	100/100**

Credits of projects & internship included

*Non-CGPA Audit Course

TOTAL NO. OF CREDITS (Without Minor) FOR BACHELOR OF SCIENCE (HONS)

Specialization in Physics/Mathematics / **Specialization in Chemistry

SEMESTER-WISE BREAKUP OF CREDITS

Sr. No	CATEGORY	SEM 1	SEM 2	SEM 3	SEM 4	SEM 5	SEM 6	TOTAL
1	Foundation Core (FC)	5	4					9
2	Program Core (PC)	19	15	15	15	15/ 14**	10/ 8**	89/ 86**
3	Program Electives (PE)					8	8	16
4	Open Electives (OE)		3	3	3			9
5	Projects (PT)						5	5
6	Seminar (SM)					1	1	2
7	Internships							NA
8	VAP	2	2	1	1	1	2	9
9	GP	1	1	1	1	1		5
10	PROPs*							*4
11	Disaster Management*							*2
	TOTAL CREDITS	27	25	20	20	26/ 25**	26/ 24**	144/ 141**

***Non CGPA Audit Course**

Minimum Credit Required:

Bachelor of Science (Hons):-
Specialization in Physics/Mathematics = 144 credits (without minor)
144 + 9 credits (with minor)

Specialization in Chemistry = 141 credits (without minor)
141** + 9 credits (with minor)

FIRST YEAR
SEMESTER I

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
EG3103	FC	English Communication	2	0	0	2	1.0	Nil
CY3205	FC	Environmental Studies	2	0	0	2	1.0	Nil
PH3106	PC	Mechanics	3	1	0	4	1.1	Nil
MA3107	PC	Calculus	3	2	0	5	1.0	Nil
CY3106	PC	Atomic Structure and Chemical Bonding	3	1	0	4	1.0	Nil
PH3141	PC	Mechanics Lab	0	0	2	1	1.1	Nil
CY3140	PC	Qualitative Analysis Lab	0	0	2	1	1.0	Nil
EG3141	FC	English and Communication Lab	0	0	2	1	1.0	Nil
VP3101	VP	Communication & Professional Skills -I	0	0	2	2	1.0	
GP3101	GP	General Proficiency	0	0	0	1	1.0	
		TOTAL	**13**	**4**	**8**	**23**		

Contact Hrs: 25

Specialization in Physics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
EC3101	PC	Basic Electrical and Electronics Engineering	3	0	0	3	1.1	Nil
EC3140	PC	Basic Electrical and Electronics Engineering lab	0	0	2	1	1.0	Nil
		TOTAL	**3**	**0**	**2**	**4**		

Contact Hrs: 5

Specialization in Chemistry

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CY3107	PC	Solid States & Ionic Equilibrium	3	0	0	3	1.0	Nil
CY3141	PC	Solid States & Ionic Equilibrium Lab	0	0	2	1	1.1	Nil
		TOTAL	**3**	**0**	**2**	**4**		

Contact Hrs: 5

Specialization in Mathematics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3106	PC	Elementary Mathematics	3	2	0	4	1.1	Nil
		TOTAL	**3**	**2**	**0**	**4**		

Contact Hrs: 5

SEMESTER II

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CS3202	FC	Fundamental of Computers and Programing in C	3	0	0	3	1.0	Nil
PH3206	PC	Electricity and Magnetism	3	0	0	3	1.0	Nil
CY3206	PC	Thermodynamics and its Applications	3	0	0	3	1.0	Nil
MA3207	PC	Differential Equations	3	2	0	4	1.1	Nil
PH3240	PC	Electricity and Magnetism Lab	0	0	2	1	1.0	Nil
CS3241	FC	Fundamentals of Computers and Programming in C Lab	0	0	2	1	1.0	Nil
	OE	Open Elective I	3	0	0	3	1.0	
VP3201	VP	Communication & ProfessionalSkills-II	0	0	2	2	1.0	
GP3201	GP	General Proficiency	0	0	0	1	1.0	
CE3201		Disaster Management*	2	0	0	2*		
		TOTAL	**17**	**2**	**6**	**21**		

***Non CGPA Audit Course**

Contact Hrs: 27

LIST OFOPEN ELECTIVE –I

S.No.	Department (Offering)	Code	Name of Subject
1	Civil Engineering	CE3011	Carbon Emission & Control
2	Computer Science and Engineering	CS3011	HTML5
3	Management + CSE	CS3021	Mining and Analysis of Big data
4	Agriculture	AG3011	Ornamental Horticulture
5	Business & Management	BB3011	Entrepreneurial Environment in India
6	Journalism	JM3011	Media Concept and Process (Print and Electronic)
7	Hospitality & Tourism	HM3011	Indian Cuisine
8	Management	MB3011	SAP 1
9	English	EG3011	French Beginner A1
10	Computer Science and Engineering	CS3031	Microsoft Office Specialist (MSO-Word)

Specialization in Physics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3207	PC	Waves and Optics	3	1	0	4	1.0	Nil
		TOTAL	**3**	**1**	**0**	**4**		

Contact Hrs: 3

Specialization in Chemistry

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CY3207	PC	s & p Block Elements	4	0	0	3	1.0	Nil
CY3242	PC	Thermo chemistry Lab	0	0	2	1	1.1	Nil
		TOTAL	**4**	**0**	**2**	**4**		

Contact Hrs: 6

Specialization in Mathematics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3206	PC	Solid Geometry and Vector Calculus	3	0	0	3	1.0	MA3107
CY3242	PC	Thermo Chemistry Lab	0	0	2	1	1.1	Nil
		TOTAL	**3**	**0**	**2**	**4**		

Contact Hrs: 5

SECOND YEAR

SEMESTER III

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3306	PC	Elements of Modern Physics	3	0	0	3	1.0	Nil
CY3308	PC	Spectroscopy	2	2	0	3	1.0	Nil
MA3308	PC	Statistical Techniques	3	2	0	4	1.0	Nil
PH3340	PC	Elements of Modern Physics Lab	0	0	2	1	1.0	Nil
	OE	Open Elective II	3	0	0	3	1.0	
VP3301	VP	Communication & Professional Skills-III	0	0	2	1		
GP3301	GP	General Proficiency	0	0	0	1	1.0	
		Total	**11**	**4**	**4**	**16**		

Contact Hrs: 19

LIST OFOPEN ELECTIVE –II

S.No.	Department (Offering)	Code	Name of Subject
1	Civil Engineering	CE3013	Environment Pollution and Waste Management
2	Computer Science and Engineering	CS3013	Java Script
3	Management + CSE	CS3023	Big Data Analytics: HDOOP Framework
4	Agriculture	AG3013	Organic farming
5	Business & Management	BB3013	Establishing a New Business
6	Journalism	JM3013	Photo Journalism
7	Hospitality & Tourism	HM3013	Chinese Cuisine
8	Management	MB3013	SAP 3
9	English	EG3013	French Intermediate B1
10	Computer Science and Engineering	CS3033	MS -Excel (Advanced) MSO Certification

Specialization in Physics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3307	PC	Mathematical Physics I	3	1	0	4	1.0	MA3107, MA3207
		Total	**3**	**1**	**0**	**4**		

Contact Hrs: 4

Specialization in Chemistry

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CY3306	PC	Co-ordination Chemistry	3	0	0	3	1.0	Nil
CY3343	PC	Quantitative Analysis Lab	0	0	2	1	1.0	Nil
		Total	**3**	**0**	**2**	**4**		

Contact Hrs: 5

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3306	PC	Real Analysis	3	2	0	4	1.0	Nil
	TOTAL		**3**	**2**	**0**	**4**		

Contact Hrs: 5

SEMESTER IV

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3406	PC	Thermal Physics	3	0	0	3	1.0	Nil
CY3406	PC	Basics of Hydrocarbons	3	0	0	3	1.0	Nil
MA3406	PC	Numerical Analysis	3	0	0	3	1.0	Nil
PH3440	PC	Thermal Physics Lab	0	0	2	1	1.0	Nil
MA3440	PC	Numerical Analysis lab	0	0	2	1	1.0	Nil
	OE	Open Elective III	3	0	0	3	1.0	
VP3401	VP	Communication & Professional Skills-IV	0	0	2	1	1.0	
GP3401	GP	General Proficiency	0	0	0	1	1.0	
		TOTAL	**12**	**0**	**6**	**16**		

Contact Hrs: 18

LIST OFOPEN ELECTIVE –III

S.No.	Department (Offering)	Code	Name of Subject
1	Civil Engineering	CE3015	Hydrology
2	Computer Science and Engineering	CS3015	J Query & Databases
3	Management + CSE	CS3025	Data Science Models : Regression, Classification and Clustering
4	Agriculture	AG3015	Mushroom Cultivation
5	Business & Management	BB3015	E-commerce
6	Journalism	JM3015	Media industry and Management
7	Hospitality & Tourism	HM3015	Italian Cuisine
8	Management	MB3015	SAP 5
9	English	EG3015	French Advance C1
10	Computer Science and Engineering	CS3035	MSO Access Certification

Specialization in Physics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3407	PC	Quantum Mechanics	2	2	0	3	1.0	Nil
PH3441	PC	Quantum Mechanics Lab	0	0	2	1	1.0	Nil
		TOTAL	**2**	**2**	**2**	**4**		

Contact Hrs: 6

Specialization in Chemistry

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CY3407	PC	Electrochemistry	3	0	0	3	1.0	Nil
CY3440	PC	Basics of Hydrocarbons Lab	0	0	2	1	1.0	Nil
		TOTAL	**3**	**0**	**2**	**4**		

Contact Hrs: 5

Specialization in Mathematics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3407	PC	Abstract Algebra	2	2	0	3	1.0	Nil
CY3440	PC	Basics of Hydrocarbons Lab	0	0	2	1	1.0	Nil
		TOTAL	**2**	**2**	**2**	**4**		

Contact Hrs: 6

THIRD YEAR
SEMESTERV

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
VP3501	VP	Communication & Professional Skills-V	0	0	2	1		
GP3501	GP	General Proficiency	0	0	0	1		
		TOTAL	0	0	2	2		

Contact Hours: 02 Hrs

Specialization in Physics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3501	PC	Mathematical Physics II	3	2	0	4	1.0	PH3307
PH3502	PC	Solid State Physics	3	2	0	4	1.0	PH3306
PH3503	PC	Advanced Electromagnetic Theory	3	2	0	4	1.0	PH3206
PH3540	PC	Mathematical Physics II Lab	0	0	2	1	1.0	PH3307
PH3541	PC	Solid State Physics Lab	0	0	2	1	1.0	PH3207
PH3542	PC	Advanced Electromagnetic Theory Lab	0	0	2	1	1.0	PH3206
	PE	Program Elective I	4	0	0	4		
	PE	Program Elective II	4	0	0	4		

PH3571	PC	Seminar I	0	0	2	1		
		TOTAL	**17**	**6**	**8**	**24**		

Contact Hours: 30 Hrs

List of Program Electives **

** A student in the 4thsem (before commencement of 1st Sessional exam of 4thsem) will opt for 8 credits of Program electives in the list of sem V. Written application to be given to the program coordinator

Semester	Elective	S. NO.	Course Code	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
V	I	1	PH3511	Digital Systems and Its Applications	3	0	2	4	1.0	PH3206
		2	PH3512	Applications of Quantum Mechanics	4	0	0	4	1.0	PH3407
	II	1	PH3513	Astronomy and Astrophysics	4	0	0	4	1.0	Nil
		2	PH3514	Nuclear and Particle Physics	4	0	0	4	1.0	PH3306
			PH3515	MOOC Course I						

NOTE : The program electives may also be taken beyond the above list from the MOOC platforms as per the availability and prior approval of the Department before offering.

Specialization in Chemistry

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CY3501	PC	Organometallic Chemistry	3	1	0	4	1.0	NIL
CY3502	PC	Heterocyclic Chemistry	3	1	0	4	1.0	NIL
CY3503	PC	Chemical Kinetics	3	1	0	4	1.0	NIL
	PE	Program Elective I	4	0	0	4	1.0	NIL
	PE	Program Elective II	4	0	0	4	1.0	NIL
CY3540	PC	Inorganic Chemistry Lab	0	0	2	1	1.0	NIL

CY3541	PC	Heterocyclic Chemistry Lab	0	0	2	1	1.0	NIL
CY3571	PC	Seminar I	0	0	2	1	1.0	NIL
		TOTAL	**17**	**3**	**6**	**23**		

Contact Hours: 26 Hrs

List of Program Electives **

** A student in the 4th sem (before commencement of 1st Sessional exam of 4th sem) will opt for 8 credits of Program electives in the list of sem V. Written application to be given to the program coordinator

SEM	Elective	S.NO	Course Code	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
Vth	I	1	CY3511	Green Chemistry	4	0	0	4	1.0	NIL
		2	CY3517	Environmental Chemistry	4	0	0	4	1.0	NIL
	II	1	CY3513	Industrial Chemical & Environment	4	0	0	4	1.0	NIL
		2	CY3514	MOOC I						

NOTE : The program electives may also be taken beyond the above list from the MOOC platforms as per the availability and prior approval of the Department before offering.

Specialization in Mathematics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3501	PC	Linear Algebra	4	2	0	5	1.0	MA3407
MA3502	PC	Linear Programming Problems	4	2	0	5	1.0	Nil
MA3503	PC	Integral Transforms	4	2	0	5	1.0	MA3207, MA3107
	PE	Program Elective-I	4	0	0	4	1.0	Nil
	PE	Program Elective-II	4	0	0	4	1.0	Nil
MA3571	PC	Seminar I	0	0	2	1	1.0	Nil
	TOTAL		**20**	**6**	**2**	**24**		

Contact Hrs: 28

List of Program Electives **

** A student in the 4th sem (before commencement of 1st Sessional exam of 4th sem) will opt for 8 credits of Program electives in the list of sem V. Written application to be given to the program coordinator

	Course Code	Category	Elective	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
Vth	MA3511	PE	I	Discrete Mathematics	4	0	0	4	1.0	Nil
	MA3512	PE	I	Differential Geometry	4	0	0	4	1.0	MA3206
	MA3513	PE	II	Mechanics I	4	0	0	4	1.0	MA3206
	MA3514	PE	II	Scientific Computing Using Matlab	4	0	0	4	1.0	MA3407

NOTE : The program electives may also be taken beyond the above list from the MOOC platforms as per the availability and prior approval of the Department before offering.

SEMESTERVI

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
VP3601	VP	Employability Skills	0	0	2	2	1.1	
		TOTAL	**0**	**0**	**2**	**2**		

Contact Hours: 2 Hrs

Specialization in Physics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
PH3601	PC	Mathematical Physics III	3	1	0	4	1.0	PH3307, PH3501
PH3602	PC	Statistical Mechanics	3	1	0	4	1.0	PH3406
PH3640	PC	Mathematical Physics III Lab	0	0	2	1	1.0	
PH3641	PC	Statistical Mechanics Lab	0	0	2	1	1.0	
	PE	Program Elective III	4	0	0	4		
	PE	Program Elective IV	4	0	0	4		
PH3670	PC	Project and Dissertation	0	0	0	5		
PH3671	PC	Seminar II	0	0	2	1		
		TOTAL	**14**	**2**	**8**	**24**		

Contact Hours: 24 Hrs

List of Program Electives **

** A student in the 4thsem (before commencement of 1st Sessional exam of 4thsem) will opt for 8 credits of Program electives in sem V and 8 credits of PE in sem VI. Written application to be given to the program coordinator

Semester	Elective	S. NO.	Course Code	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
VI	III	1	PH3611	Analog Systems and its Applications	3	0	2	4	1.0	PH3206
		2	PH3612	Classical Dynamics	4	0	0	4	1.0	PH3307
	IV	1	PH3613	Physics of Earth	4	0	0	4	1.0	PH3106
		2	PH3614	Applied Optics	4	0	0	4	1.0	PH3208
			PH3615	MOOC Course II						

NOTE : The program electives may also be taken beyond the above list from the MOOC platforms as per the availability and prior approval of the Department before offering.

Specialization in Chemistry

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CY3601	PC	Quantum Chemistry	3	1	0	4	1.0	NIL
CY3602	PC	Instrumental methods of Chemical Analysis	3	1	0	4	1.0	
	PE	Program Elective III	4	0	0	4	1.0	NIL
	PE	Program Elective IV	4	0	0	4,	1.0	NIL
CY3671	PC	Seminar II	0	0	2	1	1.0	NIL
CY3670	PC	Project & Dissertation II	0	0	0	5	1.0	NIL
		TOTAL	**14**	**2**	**2**	**22**		

Contact Hours: 18Hrs

List of Program Electives **

** A student in the 4thsem (before commencement of 1st Sessional exam of 4thsem) will opt for 8 credits of Program electives in sem V and 8 credits of PE in sem VI. Written application to be given to the program coordinator
***MOOC course needs prior approval of the Department Coordinator

SEM	Elective	S.NO	Course Code	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
VIth	III	1	CY3611	Molecules of Life	4	0	0	4	1.0	NIL
		2	CY3612	Biochemistry	4	0	0	4	1.0	NIL
	IV	1	CY3613	Research Methodology For Chemistry	4	0	0	4	1.0	NIL
		2	CY3614	MOOC II						

NOTE : The program electives may also be taken beyond the above list from the MOOC platforms as per the availability and prior approval of the Department before offering.

Specialization in Mathematics

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3601	PC	Partial Differential Equations	4	2	0	5	1.0	MA3207, MA3107
MA3602	PC	Complex Analysis	3	2	0	5	1.0	MA3306
	PE	Program Elective-III	4	0	0	4	1.0	Nil
	PE	Program Elective-IV	4	0	0	4	1.0	Nil
MA3670	PC	Project and Dissertation -II	0	0	0	5		
MA3671	PC	Seminar II	0	0	0	1	1.0	Nil
	TOTAL		**15**	**4**	**2**	**24**		

Contact Hrs: 21

List of Program Electives **

** A student in the 4thsem (before commencement of 1st Sessional exam of 4thsem) will opt for 8 credits of Program electives in sem V and 8 credits of PE in sem VI. Written application to be given to the program coordinator MOOC course needs prior approval of the Department Coordinator

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
MA3611	PE III	Metric Space	4	0	0	4	1.0	MA3306
MA3612	PE III	Advance Mechanics	4	0	0	4	1.0	MA3306
MA3613	PE IV	Number Theory	4	0	0	4	1.0	
MA3614	PE IV	The Theory of Rings	4	0	0	4	1.0	MA3407
	PE IV	MOOC						

NOTE : The program electives may also be taken beyond the above list from the MOOC platforms as per the availability and prior approval of the Department before offering.

B. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve his target number of credits as specified by the UGC and adopted by our university.

The following is the course module designed for the B.Sc. (H) (Physics) programme:

Core competency: Students will acquire core competency in Physics and in allied subject areas.

Program/Discipline Specific Elective Course (DSEC):

Skilled communicator: The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

Critical thinker and problem solver: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic &advance knowledge and concepts of physics.

Sense ofinquiry: It is expected that the course curriculum will develop an inquisitive characteristic among the students through appropriate questions, planning and reporting experimental investigation.

Ethical awareness/reasoning: A graduate student requires understanding and developing ethical awareness/reasoning which the course curriculums adequately provide.

Lifelong learner: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

Value Added Course (VAC): A value added audit course is a non-credit course which is basically meant to enhance general ability of students in areas like soft skills, quantitative aptitude and reasoning ability - required for the overall development of a student and at the same time crucial for industry/corporate demands and requirements. The student possessing these skills will definitely develop acumen to perform well during the recruitment process of any premier organization, conquering higher education and will have the anticipated confidence to face the interview. Moreover, these skills are also essential in day-to-day life of the corporate world. The aim is to nurture every student for making effective communication, developing aptitude and a general reasoning ability for a better performance, as desired in corporate world. There shall be four courses of Aptitude in Semester I, II, III&IV semesters and two courses of Soft Skills in III&IV Semesters and will carry no credit, however, it will be compulsory for every student to pass these courses with minimum

45% marks to be eligible for the certificate. These marks will not be included in the calculation of CGPI. Students have to specifically be registered in the specific course of the respective semesters.

Skill Enhancement Course: This course may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Generic/Open Elective Course (OEC): Open Elective is an interdisciplinary additional subject that is compulsory in a program. The score of Open Elective is counted in the overall aggregate marks under Choice Based Credit System (CBCS). Each Open Elective paper will be of 3 Credits in II, IIIand IV semesters. Each student has to take Open/Generic Electives from department other than the parent department. Core / Discipline Specific Electives will

not be offered as Open Electives.

Mandatory Course (MC): This is a compulsory course but audit that does not have any choice and will be of 3 credits. Each student of B.Sc. (H) Program has to compulsorily pass the Environmental Studies and Disaster management (credit not included in curriculum).

C. PROGRAM OUTCOMES OF B.Sc. Physics (Hons)

PO-01	**Disciplinary Knowledge and skill**	Understanding of major concepts, theoretical principles and experimental findings in Physics and its different subfields like Astrophysics and Cosmology, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science and other related fields of study, including broader interdisciplinary subfields like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology etc.
PO-02	**Critical thinker and problem solver**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO-03	**Design/Development of Solutions**	Design solutions for complex engineering problems and design System components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO-04	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO-05	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex physical activities with an understanding of the limitations.
PO-06	**The Physicist and society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO-07	**Environment and sustainability**	Understand the impact of the professional solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO-08	**Communication**	Incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

PO-09	**Ethics**	Responsible citizen of India and be aware of moral and ethical baseline of the country and the world. They are expected to define their core ethical virtues good enough to distinguish what construes as illegal and crime in Indian constitution. Emphasis be given on academic and research ethics, including fair Benefit Sharing, Plagiarism, Scientific Misconduct and so on.
PO-10	**Individual and Team work**	Provide opportunity to act as team player by contributing in laboratory, field-based situation and industry.
PO-11	**Project Management and Finance**	become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.
PO-12	**Life-long learning**	Inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

D. Program Specific Outcomes:

PSO 1: Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.

PSO 2: Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.

PSO 3: Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.

E. Program Educational Objectives (PEO's)

PEO 1 : Emphasize the discipline of Physics to be the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.

PEO 2 : Emphasize the importance of Physics as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

PEO 3 : Enhance their professional career through lifelong learning to take-up challenging tasks and adapt to a rapidly changing environment

F. Pedagogy & Unique practices adopted:

"Pedagogy is the method and practice of teaching, especially for teaching an academic subject or theoretical concept". In addition to conventional time-tested lecture method, the institute will emphasize on experiential learning:

Role Play & Simulation: Role- play and simulation are forms of experiential learning. Learners take on different roles, assuming a profile of a character or personality, and interact and participate in diverse and complex learning settings. Role-play and simulation function as learning tools for teams and groups or individuals as they "play" online or face-to-face. They alter the power ratios in teaching and learning relationships between students and

educators, as students learn through their explorations and the viewpoints of the character or personality they are articulating in the environment. This student-centered space can enable learner-oriented assessment, where the design of the task is created for active student learning. Therefore, role-play& simulation exercises such as virtual share trading, marketing simulation etc. are being promoted for the practical-based experiential learning of our students.

Video Based Learning (VBL)&Learning through Movies (LTM): These days technology has taken a front seat and classrooms are well equipped with equipment and gadgets. Video-based learning has become an indispensable part of learning. Similarly, students can learn various concepts through videos. In fact, many teachers give examples from videos during their discourses. Making students learn few important theoretical concepts through VBL & LTM is a good idea and method. The learning becomes really interesting and easy as videos add life to concepts and make the learning engaging and effective. Therefore, our institute is promoting VBL& LTM, wherever possible.

Projects and Dissertation: The students, who take up experiential projects in project and Dissertation offer in final year, where senior faculties with a stake in teaching guide them, drive the learning. All students are encouraged to do some technical project other their regular classes.

Industrial Visits: Industrial visit are essential to give students hand-on exposure and experience of how things and processes work in industries. Our institute organizes such visits to enhance students' exposure to practical learning and work out for a report of such a visit relating to their specific topic, course or even domain.

MOOCs: Students may earn credits by passing MOOCs as decided by the college. Graduate level programs may award Honors degree provided students earn pre-requisite credits through MOOCs. University allows students toundertake additional subjects/course(s) (In-house offered by the university through collaborative efforts or courses in the open domain by various internationally recognized universities) and to earn additional credits on successful completion of the same. Each course will be approved in advance by the University following the standard procedure of approval and will be granted credits as per the approval. Keeping this in mind, University proposed and allowed a maximum of four credits to be allocated for each MOOC courses. In the pilot phase it is proposed that a student undertaking and successfully completing a MOOC course through only NPTEL could be given 4 credits for each MOOC course.

For smooth functioning and monitoring of the scheme the following shall be the guidelines forMOOC courses, Add-on courses carried out by the College from time to time.

a) It will necessary for every student to take at least one MOOC Course throughout the programme.

b) There shall be a MOOC co-ordination committee in the College with a faculty at the level of Professor heading the committee and all Heads of the Department being members of the Committee.

c) The Committee will list out courses to be offered during the semester, which could be requested by the department or the students and after deliberating on all courses finalize a list of courses to be offered with 4credits defined for each course and the mode of credit consideration of the student. The complete process shall be obtained by the College before end of June and end of December for Odd and Even semester respectively of the year in which the course is being offered. In case of MOOC course, the approval will be valid only for the semester on offer.

d) Students will register for the course and the details of the students enrolling under the course along with the approval of the Vice Chancellor will be forwarded to the Examination department within fifteen days of start of the semester by the Coordinator MOOC through the Principal of the College.

e) After completion of MOOC course, Student will submit the photo copy of Completion certificate of MOOC Course to the Examination cell as proof.

f) Marks will be considered which is mentioned on Completion certificate of MOOC Course.

g) College will consider the credits only in case a student fails to secure minimum required credits then the additional subject(s) shall be counted for calculating the minimum credits required for the award of degree.

Special Guest Lectures (SGL) &Extra Mural Lectures (EML): Some topics/concepts need extra attention and efforts as they either may be high in difficulty level or requires experts from specific industry/domain to make things/concepts clear for a better understanding from the perspective of the industry. Hence, to cater the present needs of industry we organize such lectures, as part of lecture-series and invite prominent personalities from academia and industry from time to time to deliver their vital inputs and insights.
Student Development Programs (SDP): Harnessing and developing the right talent for the right industry an overall development of a student is required. Apart from the curriculum teaching various student development programs (training programs) relating to soft skills, interview skills, SAP, Advanced excel training etc. that may be required as per the need of the student and industry trends, are conducted across the whole program. Participation in such programs is solicited through volunteering and consensus.

Industry Focused programmes: Establishing collaborations with various industry partners to deliver the programme on sharing basis. The specific courses are to be delivered by industry experts to provide practice-based insight to the students.

Special assistance program for slow learners& advance learners: There is dedicated system to assessing and identify the slow and fast learner students. After this, a mechanism to correcting knowledge gap through, special program for slow and fast learner. In terms of advance topics / research based problems were used to learning challenges will be provided to the fast learners.

Induction program: Every year 3 weeks induction program is organized for 1st year students and senior students to make them familiarize with the entire academic environment of university including Curriculum, Classrooms, Labs, Faculty/ Staff members, Academic calendar and various activities.

Mentoring scheme: There is Mentor-Mentee system. One mentor lecture is provided per week in a class. Students can discuss their problems with mentor who is necessarily a teaching faculty. In this way, student's problems or issues can be identified and resolved.

Competitive exam preparation: Students are provided with one class in every week for GATE/ Competitive exams preparation.

Extra-curricular Activities: Organizing & participation in extracurricular activities will be mandatory to help students develop confidence & face audience boldly. It brings out their leadership qualities along with planning & organizing skills. Students undertake various cultural, sports and other competitive activities within and outside then campus. This helps them build their wholesome personality.

Career & Personal Counseling: - Identifies the problem of student as early as possible and gives time to discuss their problems individually as well as with the parents. Counseling enables the students to focus on behavior and feelings with a goal to facilitate positive change. Its major role lies in giving: Advice, Help, Support, Tips, Assistance, and Guidance.

Participation in Flip Classes, Project based Learning (A2 Assignment), Workshops, Seminars &writing & Presenting Papers: Departments plan to organize the Flip Classes; Project based Learning (A2 Assignment), workshops, and Seminars& Guest lecturers time to time on their respective topics as per academic calendar. Students must have to attend these programs. This participation would be count in the marks of general Discipline & General Proficiency which is the part of course scheme as non-credit course.

Formation of Student Clubs, Membership & Organizing & Participating events: Every department has the departmental clubs with the specific club's name. The entire student's activity would be performed by the club. One faculty would be the coordinator of the student clubs & students would be the members with different responsibility.

Capability Enhancement & Development Schemes: The Institute has these schemes to enhance the capability and holistic development of the students. Following measures/ initiatives are taken up from time to time for the same: Career Counseling, Soft skill development, Remedial Coaching, Bridge Course, Language Lab, Yoga and Meditation, Personal Counseling

Library Visit & Utilization of QLRC: Students may visit the library from morning10 AM to evening 8 PM. Library created its resources Database and provided Online Public Access Catalogue (OPAC) through which users can be accessed from any of the computer connected in the LAN can know the status of the book. Now we are in process to move from OPAC to KOHA.

Detailed Syllabus (Semester wise /course wise)

Year -1

SEMESTER 1

EG3103	**Title: English Communication**	**L T P C** **2 0 0 2**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	To impart basic English communication skills to the student-writing, speaking, reading and listening.	
Expected Outcome	The student will gain a sound understanding of the basics of English which will help him in social and professional situations.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Fundamentals of Communication**	5
Communication Process; Definition, Importance; Forms of Communication, Channels of Communication; Barriers to Communication: Qualities of a Good Communicator.		
Unit II	**Types of Communication**	5
Verbal and Non-verbal Communication: Audio-Visual Communication; Effective speaking; Types of Non-verbal communication- Kinesics, Proxemics, Chronemics, Paralanguage.		
Unit III	**Listening Skills**	4
Definition and Importance; Types of Listening Skills; Intelligent Listening; Barriers to Listening and overcoming Barriers; SWOT Analysis.		
Unit IV	**Writing Skills**	5
Use of Grammar; Business Correspondence; Presentations; Report Writing, Project; Notice and Circulars.		
Unit V	**Use of Communication Skills**	5
Basics of Phonetics; Presentation Skills- Dos & Don'ts; Extempore, Debate, Role Play, Interview, Group Discussion.		
Text Books	1.Ruby Gupta, Basic Technical Communication, Foundation Books.	
Reference Books	1.P K Agrawal and A K Mishra, Business Communication, SahityaBahwan Publication. 2. Vinod Mishra and NarendraSukla, Business Communication, SBPD Publishing House. 3.N Gupta and P Mahajan, Business Communication, SahityaBahwan Publication.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	20-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for EG3103

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to discuss the concept of communication skills	1	S
CO2	Students will be able to increase self awareness about english language.	2	S
CO3	Students will be able to develop public speaking abilities.	1	S
CO4	Students will be able to present each and everything in correct manner.	2	Enp
CO5	Students will be able to discuss the concept of barriers to communication.	2	None

CO-PO Mapping for EG3103

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	2	2	1	1	3	1	3	1	2	1	3	2
CO 2	2	1	1	2	0	1	2	2	2	2	2	3	0	2	3
CO 3	2	2	2	0	2	2	1	3	1	2	2	1	1	2	2
CO 4	1	1	2	2	2	0	3	2	2	2	2	1	1	1	2
CO 5	2	2	1	1	1	2	2	3	1	2	2	3	2	0	1
Avg	1.6	1.6	1.6	1.4	1.4	1.2	1.8	2.6	1.4	2.2	1.8	2.0	1.0	1.6	2.0

CY3205	Title: Environmental Studies	L T P C 2 0 0 2
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Creating awareness among engineering students about the importance of environment, the effect of technology on the environment and ecological balance is the prime aim of the course.	
Expected Outcome	Students will understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Environmental studies & Ecosystems	5
Multidisciplinary nature of environmental studies, Scope and importance, Need for public awareness. Concept, Structure and function of an ecosystem, Energy flow in an ecosystem: food chains, food webs and ecological pyramids. Examples of various ecosystems such as: Forest, Grassland, Desert, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)		
Unit II	Natural Resources: Renewable & Non- renewable resources	5
Land as a resource, land degradation, landslides (natural & man-induced), soil erosion and desertification. Forests & forest resources: Use and over-exploitation, deforestation. Impacts of deforestation, mining, dam building on environment and forests. Resettlement and rehabilitation of project affected persons; problems and concerns with examples. Water resources: Use and over-exploitation of surface and ground water, floods, drought, conflicts over water (international & inter-state). Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems with examples. Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs.		
Unit III	Biodiversity & Conservation	5
Levels of biological diversity: genetic, species and ecosystem diversity. Bio geographic zones of India. Ecosystem and biodiversity services. Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. Conservation of biodiversity: In-situ and Ex-situ conservation.		
Unit IV	Environmental Pollution	4
Environmental pollution and its types. Causes, effects and control measures of :a) Air pollution b) Water pollution – freshwater and marine c) Soil pollution d) Noise pollution e) Thermal pollution Nuclear hazards and human health risks, Solid waste management: Control measures of urban and industrial waste.		
Unit V	Environmental Policies & Practices	5
Concept of sustainability and sustainable development. Water conservation & watershed management. Climate change, global warming, acid rain, ozone layer depletion. Disaster management: floods, earthquake, cyclones and landslides. Wasteland reclamation. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Environment: rights and duties. Population growth. **Field work** Visit to a local polluted site-Urban/Rural/Industrial/Agricultural , Study of simple ecosystems-pond, river, hill slopes, etc.		
Text Books	1. Bharucha. E, Textbook of Environmental Studies for Undergraduate Courses.	
Reference Books	1. KaushikAnubha, Kaushik C P, Perspectives in Environmental Studies New Age Publication	
Mode of Evaluation	Internal and External Examinations	

Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3205

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students can be able to correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and preventions.	1	S
CO2	Students should be able to understand the solutions related to environmental problems related with the renewable & non-renewable resources.	2	S
CO3	Students should be able to understand the importance of ecosystem and biodiversity and the method of conservation of biological diversity.	1	S
CO4	Students should be able to understand different components of the environment and their function and the effects pollution on environment and should be able to understand the concept of sustainable development.	2	None
CO5	Students should be able to correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and preventions.	2	En

CO-PO Mapping for CY3205

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	2	2	1	2	2	3	1	2	2	1	2
CO 2	2	3	1	2	1	2	2	3	3	2	2	2	2	1	2
CO 3	3	2	2	1	1	2	2	2	2	2	0	2	2	0	1
CO 4	2	2	3	1	2	2	1	2	2	1	2	3	2	1	1
CO 5	2	2	1	1	1	2	1	2	3	2	1	3	2	2	2
Avg	2.2	2.2	1.8	1.2	1.4	2.0	1.4	2.2	2.4	2.0	1.2	2.4	2.0	1.0	1.6

PH3106	Title: Mechanics	L T P C 3 1 0 4
Version No.	1.1	
Course Prerequisites	Nil	
Objectives	To Study the basics of Mechanics	
Expected Outcome	The student will gain understanding of the basics of Mechanics which will help him in understanding practical life situations	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Work and Energy	9
Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.		
Unit II	Collisions & Rotational Dynamics	8
Centre of Mass, Principle of conservation of momentum Impulse, Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.		
Unit III	Gravitation	5
Lawofgravitation.Gravitationalpotentialenergy.Inertial&gravitational mass.Potentialandfieldduetosphericalshellandsolidsphere.Kepler's Laws. Satellite in circular orbit & applications.		
Unit IV	Central force Motion and Oscillations	7
Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. **Review of SHM (**Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time - average values). Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.		
Unit V	Non-Inertial Systems& Special Theory of Relativity	7
Non-inertial frames and fictitious forces. Uniformly rotating frame. Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Mass less Particles. Mass-energy Equivalence.		
Text Books	1. J.W.Jewett,R.A.Serway, Physics for scientists and Engineers withModernPhys. 2. M.R.Spiegel, Theoretical Mechanics,TataMcGrawHill.	
Reference Books	1. D.Kleppner,R.J.Kolenkow, An introductiontomechanics,TataMcGrawHill. 2. C.Kittel,W.Knight et.al., Mechanics,BerkeleyPhysics,Vol.1,TataMcGrawHill. 3. Resnick,HallidayandWalker, Fundamentals of physics, Wiley 4. Hans Ohanian, Physics for Engineers and scientist, W W Norton and Company 5. R.P.Feynman,R.B.Leighton,M.Sands, FeynmanLectures,Vol.I,PearsonEducation 6. F.W. Sears,M.W.Zemansky,H.D. Young, UniversityPhysics, AddisonWesley 7. D.S.Mathur, Mechanics,S.ChandandCompanyLimited.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3106

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to understand the role of vectors and coordinate systems in Physics. Explain the conservation of energy, momentum, angular momentum and apply them to basic problems	2	Em
CO2	Students will be able to Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions. Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.	2	S
CO3	Students will be able to explain gravitational field and apply Kepler's law to describe the motion of planets and satellite in circular orbit.	3	S
CO4	Students will be able to explain the phenomena of simple harmonic motion and damped and driven harmonic motion and the properties of systems executing such motions.	2	S
CO5	Students will be able to describe how fictitious forces arise in a non-inertial frame, special relativistic effects and their effects on the mass and energy of a md	3	S

CO-PO Mapping for PH3106

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	3	2	1	3	1	2	2	2	2	2	2	3	2
CO 2	2	2	2	2	1	3	2	3	2	2	0	3	0	2	3
CO 3	2	2	3	2	2	3	2	2	2	3	2	2	2	2	2
CO 4	2	1	2	1	2	1	2	3	2	3	2	3	2	3	0
CO 5	1	2	3	2	2	3	2	2	3	3	2	3	2	2	3
Avg	1.6	1.8	2.6	1.8	1.6	2.6	1.8	2.4	2.2	2.6	1.6	3.0	1.6	2.4	2.0

MA3107	Title: Calculus	L T P C 3 2 0 5
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To impart the knowledge of motion of curves.	
Expected Outcome	Students will be able to solve applied problems using differentiation an integration.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Successive Differentiation and Curve tracing	10
Successive Differentiation, Leibniz rule, Sketching of Graphs using Derivatives, concavity and inflection points, asymptotes:-condition of existence of asymptote, parallel to axes & alternative approach, curve tracing in Cartesian coordinates, Indeterminate Forms.		
Unit II	Parametric Equations and Definite Integration	10
Parametric Equations and Their Representations, Definite integral, Application of Integration; Area of a plane region between two curves, Volume of a solid of revolution, Area of a Surface of Revolution.		
Unit III	Partial Differentiation	9
Partial Differentiation; Tangent planes and Increment Approximation, Total differential, Jacobian.		
Unit IV	Extreme of Functions of Several variables	9
Extreme of Functions of Several Variables, Lagrange Multipliers with single and two constraints.		
Unit V	Multiple Integral	10
Double and triple integrals, Change of order in double integrals. Beta and Gamma functions, Simple Application of Dirichlet.		
Text Books	1. R.K.. Jain and S R K Iyengar, Advanced Engineering Mathematics, Narosa publication 2. Gorakh Prasad, Differential Calculus, Pothishala Private Ltd. Allahabad. 3. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.	
Reference Books	1. G.B. Thomas and R.L. Finney, *Calculus,*Pearson Education, Delhi. 2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus,* Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi. 3. H. Anton, I. Bivens and S. Davis, *Calculus,* John Wiley and Sons (Asia) P. Ltd., Singapore. 4. R. Courant and F. John, *Introduction to Calculus and Analysis* (Volumes I & II), Springer-Verlag, New York, Inc.	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3107

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Student will learn to find successive differentiation and apply leibniz rule for finding higher order and learn to find concavity and point of inflexion of the curve,tracing of curve in cartesian coordinate, indeterminate forms	3	S
CO2	Students will be able to work with parametric equation and their representation and will learn about definite integral and application of integraion and find the area of a plane region between two curves, area of a surface of revolution.	3	S
CO3	Students will be able to understand the concept of partial differentiation and learn about increment approximation, total differential and Jacobian.	3	S
CO4	Students will be able to find the maxima and minima of function of several variables and learn the lagrange multipliers method for finding extreme of function.	2	S
CO5	Students will learn to solve double and triple intrgral, change of order in double integral and understand beta and gamma functions and application of dirichletcobdition .	2	S

CO-PO Mapping for MA3107

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	1	2	1	1	2	2	2	1	2	2	2	2	2
CO 2	3	2	2	3	1	3	2	2	3	2	1	2	3	2	1
CO 3	1	3	2	2	0	1	2	3	2	3	1	2	0	3	2
CO 4	2	2	1	1	2	2	2	2	2	2	2	1	1	1	2
CO 5	3	3	2	2	2	3	1	2	2	2	2	2	3	2	1
Avg	2.2	2.4	1.6	2.0	1.2	2.0	1.8	2.2	2.2	2.0	1.6	1.8	1.8	2.0	1.6

CY3106	Title: Atomic Structure & Chemical Bonding	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To acquire basic knowledge about atomic structure, bonding, molecular structure of various compounds	
Expected Outcome	Understanding the atomic structure, basics of quantum chemistry and its applications.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Atomic Structure	8
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics:de Broglie equation, Heisenberg's uncertainty principle and its significance, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations		
Unit II	Quantum Numbers	8
Variation of orbital energy with atomic number. Schrodinger's wave equation. Quantum numbers and their significance. Normal and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions. Shapes of *s*, *p*, *d* and *f* orbital's.		
Unit III	Chemical Bonding: Ionic Bond	8
General characteristics, types of ions, size effects, radius ratio ruleand its limitations. Packing of ions in crystals. Born-Lande equation withderivation and importance of Kapustinskii expression for lattice energy.Madelung constant, Born-Haber cycle and its application, Solvation energy. Covalent character in ionic compounds, polarizing power and polarizability.Fajan's rules and consequences of polarization.		
Unit IV	Chemical Bonding: Covalent Bond	10
Lewis structure, Valence Bond theory (Heitler-London approach).Hybridization, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl, BeF2, CO2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding, and bond lengths. Ionic character in covalent compounds: Bond moment and dipole moment.		
Unit V	Metallic Bond & Chemical forces	8
Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment)		
Text Books	1. Cotton, F.A., Wilkinson, G. &Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley. 2. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.	
Reference Books	1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS 2. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3106

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students able to know the structures, properties, application and the chemical reactivity.	2	S
CO2	Students will gain knowledge on fundamental of chemistry of the main group elements, and importance and real world application of many of these elements	2	S
CO3	Students will gain knowledge on the general characteristics of ions, size and effects.	1	S
CO4	Qualitative idea of valence bond and band theories.	2	S
CO5	Students able to know the Quantum numbers and their significance.	2	S

CO-PO Mapping for CY3106

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	2	1	2	1	0	3	2	2	3	1	1	2	0	1	1
CO 2	1	1	2	2	1	1	1	1	2	2	2	1	1	2	2
CO 3	1	1	1	1	1	2	2	2	2	1	1	1	1	2	2
CO 4	1	1	1	1	1	2	1	1	2	1	1	1	1	2	1
CO 5	1	1	1	1	2	1	1	3	2	1	2	2	1	1	2
Avg	1.2	1.0	1.4	1.2	1.0	1.8	1.4	1.8	2.2	1.2	1.4	1.4	0.8	1.6	1.6

PH3141	Title: Mechanics Lab	L T P C 0 0 2 1
Version No.	1.1	
Course Prerequisites	Nil	
Objectives	To make students familiar with the fundamental laws featuring in the field of mechanics	
Expected Outcome	Students shall conceptualize and firmly grasp the basic physics & mechanics with knowledge of fundamental reporting of experimental results	
	List of Experiments	

At least 08 experiments from the following

1. To study the random error in observations.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a)Spring constant, (b) g and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine g and velocity for a freely falling body using Digital Timing Technique
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
8. To determine the elastic Constants of a wire by Searle's method.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum.

Text Books	
Reference Books	1. B. L. Flint and H.T. Worsnop,Advanced Practical Physics for students, Asia Publishing House 2. Michael Nelson and Jon M. Ogborn,Advanced level Physics Practicals, HeinemannEducational Publishers 3. S.Panigrahi&B.Mallick,Engineering Practical Physics, Cengage Learning India Pvt. Ltd. 4. G.L. Squires,Practical Physics, Cambridge University Press. 5. I.Prakash& Ramakrishna, A Text Book of Practical Physics, Kitab Mahal
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3141

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will acquire knowledge of how to handle measuring instruments (like screw gauge, vernier calipers, Travelling microscope) and graphing data for analysis	2	S
CO2	Students will have hands on experience on verifying various principles learnt in theory. Measuring 'g' using Bar Pendulum, Kater pendulum	3	S
CO3	Students will be able to Measure elastic constants of materials.	3	S

CO-PO Mapping for PH3141

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	2	2	1	2	3	2	3	2	3	2	2	3
CO 2	2	2	1	2	2	1	2	3	3	3	2	3	2	2	2
CO 3	3	3	2	2	2	2	2	1	2	3	2	2	2	2	1
Avg	2.7	2.3	1.3	2.0	2.0	1.3	2.0	2.3	2.3	3.0	2.0	2.7	2.0	2.0	2.0

CY3140	Title: :Qualitative Analysis Lab	L T P C 0 0 2 1
Version No.	1.1	
Course Prerequisites		
Objectives	To provide practical knowledge about preparation of standard solutions and different kinds of titrations.	
Expected Outcome	Student will be able to learn Calibration of instruments and meth involved by performing experiments.	
Exp No	Experiment Title	

1. Measurement of pH of different solutions using pH-meter.

2. Preparation of buffer solutions

   (i) Sodium Acetate-Acetic acid
   (ii) Ammonium Chloride-Ammonium Hydroxide

3. Measurement of the pH of buffer solutions and comparison of the values theoretical values.

4. pH metric titrations ofstrong acid and strong base

5. pH metric titrations ofweak acid and strong base

6. Estimation of Carbonate and Hydroxide present together in mixture.

7. Estimation of Carbonate and Bicarbonate present together in a mixture.

8. Estimation of Fe (II) and Oxalic acid using standardized $KMnO_4$ solution.

9. Estimation of Oxalic acid and Sodium Oxalate in a given mixture.

10. Estimation of Fe (II) with $K_2Cr_2O_7$ using internal (diphenylamine,anthranilic acid) and external indicator.

Reference Books	Pandey, Bajpai, &Giri, “Practical Chemistry”, S.Chand Publication.
Mode of Evaluation	Internal and External Examinations
Recommendation by Bo Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will gain hands on experience on different kinds of titrations.	1	Em
CO2	Students will able to learn calibration of instruments and methods involved by performing experiments.	2	S
CO3	Students will be able to know the preparation of standard solutions.	3	S

CO-PO Mapping for CY3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	1	2	1	0	3	2	2	3	1	1	2	0	1	1
CO 2	1	1	2	2	1	1	1	1	2	2	2	1	1	2	2
CO 3	1	1	1	1	1	2	2	2	2	1	1	1	1	2	2
Avg	1.2	1.0	1.4	1.2	1.0	1.8	1.4	1.8	2.2	1.2	1.4	1.4	0.8	1.6	1.6

EG3141	**Title: English Communication Lab**	**L T P C** **0 0 2 1**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	To enable students to enhance English language skills and to practice soft skills	
Expected Outcome	The student will develop good skills in English communication which will enable him to handle various life situations confidently.	
List of Experiments		

1.Grammar-tenses practice
2.Listening comprehension exercises
3.Responding in everyday life situations
4.Common conversation skills
Requesting- Responding to Requests
Congratulating
Expressing sympathy and condolences
Expressing Disappointment
5.Asking Questions-Polite responses
6. Apologizing-,Forgiving
7.Giving Instructions
Getting and Giving Permission
8.Group discussion
9.Public speaking
10. Mother tongue influence and correction

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	20-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for EG3141

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to develop public speaking abilities.	2	Em
CO2	Students will be able to speak of each topic.	3	S
CO3	Students will be able to increase self awareness about english language.	2	S

CO-PO Mapping for EG3141

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	2	2	2	2	1	2	1	2	2	3
CO 2	1	1	1	0	2	2	3	2	3	2	2	2	1	2	2
CO 3	1	2	2	2	1	2	1	2	1	1	2	2	0	2	2
Avg	1.3	1.7	1.7	1.3	1.7	2.0	2.0	2.0	2.0	1.3	2.0	1.7	1.0	2.0	2.3

EC3101	Title: Basic Electrical and Electronics Engineering	L T P C 3 0 0 3
Version No.	1.1	
Course Prerequisites	Nil	
Objectives	To provide an overview of electrical and electronics fundamentals.	
Expected Outcome	The student would acquire the knowledge of basics fundamentamentals of electrical and electronics.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Basic Concepts of Electrical Engineering	7
Electric Current, Electromotive force, Electric Power, Ohm's Law, Basic Circuit Components, Faraday's Law of Electromagnetic Induction, Lenz's Law, Kirchhoff's laws, Network Sources, Resistive Networks, Series-Parallel Circuits, Node Voltage Method, Mesh Current Method. Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems.		
Unit II	Alternating Quantities	7
Alternating Quantities: Introduction, Generation of AC Voltages, Root Mean Square and Average Value of Alternating Currents and Voltages, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, Single Phase RLC Circuits, Introduction to 3-Phase AC System.		
Unit III	Transformers	8
Transformers: Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers.		
Unit IV	Basic Electronics	7
Conduction in Semiconductors, Conduction Properties of Semiconductor Diodes, Behavior of PN Junction, PN Junction Diode, Zener Diode, Photovoltaic Cell, Rectifiers, Bipolar Junction Transistor, Field Effect Transistor, Transistor as an Amplifier.		
Unit V	Digital Electronics and Electrical Measuring Instruments	7
Digital Electronics:Boolean algebra, Binary System, Logic Gates and Their Truth Tables.Kaurnugh Map, Electrical Measuring Instruments: Basic OP-AMP, Differential amplifier, PMMC instruments, shunt and series multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watthour meter, extension of instrument ranges.		
Text Books	1. V. Jagathesan, K. Vinod Kumar & R. SaravanKumar,Basic Electrical & Electronics Engineering Wiley India. 2. Sukhija and Nagsarkar,Basic Electrical and Electronics Engineering Oxford Publication	
Reference Books	1. Kothari, Nagrath,Basic Electrical & Electronics Engineering TMH 2. Prasad Sivanagraju,Basic Electrical & Electronics Engineering Cengage learning Indian Edition 3. Muthusubrmaniam,Basic Electrical and Electronics Engineering by TMH	
Mode of Evaluation	Internal and External Examinations.	
Recommendation by Board of Studies on	06-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for EC3101

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to understand the fundamentals of AC & DC circuits and network analysis using various theorems	2	S
CO2	Students will learn the construction and testing of transformers, AC parameters, RLC circuits and three phase system	2	S
CO3	Students will learn working and application of single/ three phase type AC machines, and DC machines	2	S
CO4	Students will be able to transport phenomenon in semiconductors, electronic devices and applications	3	S
CO5	Students will gain knowledge on Boolean algebra, binary gates, op-amps and electrical measuring instruments,	2	S

CO-PO Mapping for EC3101

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	2	2	1	1	2	2	1	2	3	0	2	1
CO 2	2	1	1	2	3	3	2	2	3	2	2	2	2	1	1
CO 3	2	1	2	3	2	2	2	3	2	3	1	2	3	2	2
CO 4	1	2	2	2	1	1	1	2	2	2	2	1	2	2	2
CO 5	3	2	1	1	2	2	2	2	3	1	2	2	2	2	2
Avg	2.0	1.4	1.4	2.0	2.0	1.8	1.6	2.2	2.4	1.8	1.8	2.0	1.8	1.8	1.6

EC3140	Title: Basic Electrical and Electronics engineering Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To make students familiar with the fundamental laws featuring in the field of Electrical and Electronics Engineering.	
Expected Outcome	Students shall conceptualize and firmly grasp the basic electrical & electronic engineering laws along with the knowledge of fundamental circuits governing the functioning of important devices.	

List of Experiments

1. To verify the Kirchhoff's current and voltage laws.
2. To verify the Superposition theorem.
3. To verify the Thevenin's theorem.
4. To verify the Norton's theorem.
5. To verify the maximum power transfer theorem.
6. To study the V-I characteristics of p-n junction diode.
7. To study the diode as clipper and clamper.
8. To study the half-wave & full-wave rectifier using silicon diode.
9. To study transistor in Common Base configuration & plot its input/output characteristics.
10. To study various logic gates & verify their truth tables.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	06-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for EC3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to verify Kirchhoff's current and voltage laws	2	S
CO2	Students will know and will be able to apply the Thevenin's, Norton's, superposition and maximum power transfer theorem, Analyze the half-wave and full-wave rectifier using silicon diode	2	S
CO3	Students will be bale to understand and analyze the characteristics of transistors and semiconductor diodes,To know about basic concepts of various logic gates	3	S

CO-PO Mapping for EC3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	2	2	1	1	2	2	3	2	2	3	2	1	2	2	1
CO 2	2	1	3	2	3	3	2	3	2	2	3	2	2	1	1
CO 3	2	1	2	1	2	2	2	3	3	3	1	2	0	2	2
Avg	2.0	1.3	2.0	1.3	2.3	2.3	2.3	2.7	2.3	2.7	2.0	1.7	1.3	1.7	1.3

Specialization in Chemistry

CY3107	Title: Solid States & Ionic Equilibrium	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
3bjectives	To grasp the concepts of thermodynamics, thermo chemistry, chemical equilibrium	
Expected Outcome	Learning the solubility of ionic compounds and their solution properties	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Solid States	6
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices.		
Unit II	Diffraction	6
X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.		
Unit III	Ionic Equilibrium	8
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acidsand bases, pH scale, common ion effect; dissociation constants of mono-, di- and tri-protic acids (exact treatment).		
Unit IV	Solution	8
Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.		
Unit V	Solubility	8
Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid – base indicators; selection of indicators and their limitations.Multistage equilibrium in polyelectrolyte systems; hydrolysis and hydrolysis constants.		
Text Books	1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., OxfordUniversity Press. 2. Barrow, G.M. Physical Chemistry Tata McGraw-Hill. .	
Reference Books	1. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi. 2. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier.	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3107

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be gaining knowledge on basics and advance concepts regarding the three states of matter.	1	S
CO2	Students will be gaining knowledge on diffraction and their analysis.	2	S
CO3	Students will be gaining knowledge on ionic equilibrium.	2	S
CO4	Students will be gaining knowledge on solutions and its applications.	2	En
CO5	Students will be gaining knowledge on solubility and their application's,	2	None

CO-PO Mapping for CY3107

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	2	2	3	2	1	2	1	1	1	1	2
CO 2	1	1	1	2	1	1	1	2	1	2	1	2	1	1	2
CO 3	1	2	1	1	1	2	1	2	1	1	1	2	1	1	2
CO 4	1	2	1	1	1	1	1	2	1	2	1	2	2	1	1
CO 5	2	2	1	1	2	1	1	2	1	2	1	2	2	1	1
Avg	1.2	1.8	1.0	1.2	1.4	1.4	1.4	2.0	1.0	1.8	1.0	1.8	1.4	1.0	1.6

CY3141	Title: Solid States & Ionic Equilibrium Lab	L T P C 0 0 2 1
Version No.	1.1	
Course Prerequisites		
Objectives	To understand the concept of Surface tension and Viscosity	
Expected Outcome	Learning application of physical chemistry laws experimentally	
Exp No	ExpTtitle	

1. To determine the surface tension by Drop number

2. To determine the surface tension by Drop weight method.

3. Study the effect of variation of viscosity of an aqueous solution with the concentration of solute.

4. Preparation of buffer solution of Sodium acetate-acetic acid

5. To determine the relative surface tension of a liquid with respect to water at room temperature by Stalgmometer.

6. The adsorption of aqueous acetic acid by activated charcoal and to study the adsorption isotherm.

7. To determine the solubility of salt at three different temperatures.

Text Books	**Reference text:** 1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 2. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi
Reference Books	
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3141

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will understand the concept of surface tension and viscosity.	2	Em
CO2	Students will be gaining knowledge on application of physical chemistry laws experimentally.	2	S
CO3	Students will gain hands on experience on preparation of buffer solutions and determine the solubility of salt.	1	S

CO-PO Mapping for CY3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	2
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	2	2	2	1	1	1	1	1	2	2	2	1	1	2
Avg	1.0	1.3	1.7	1.3	1.3	1.0	1.0	1.3	1.3	2.0	1.3	1.3	1.0	1.0	2.0

Specialization in Mathematics

MA3106	Title: Elementary Mathematics	L T P C 3 2 0 4
Version No.	1.1	
Course Prerequisites	Nil	
Objectives	To impart the knowledge of Trigonometry, Matrices and theory of Equations.	
Expected Outcome	Students will be able to demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithmic, and trigonometric functions.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Trigonometry	8
Introduction to inverse circular and hyperbolic functions and their properties. Logarithm of a complex quantity. Gregory's series. Summation of trigonometric series, Difference method, C + iS method.		
Unit II	Matrix and Algebra	8
Elementary Operations on matrices. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix . Rank of matrix, Eigen values, eigenvectors of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its application .		
Unit III	System of Equations	8
Solution of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations.		
Unit IV	Theory of Equations	6
Existence of root of equation, Descarte's rule, general polynomial equation in one variable.		
Unit V	Solution of Equations	6
Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.		
Text Books	1. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad 2. S.L. Loney ,Plane Trigonometry Part – II, Macmillan and Company, London	
Reference Books	1. Shanti Narayan , A Text Books of Matrices. 2. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad. 3. S.L. Loney ,Plane Trigonometry Part – II, Macmillan and Company, London.	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3106

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will learn about trigonometric and inverse trigonometric functions and will be able solve trigonometric equations and applications and apply and prove trigonometric identities.	3	S
CO2	Students will be able to work with matrices and determine if a given square matrix is invertible and Solve the Eigen values and eigenvectors of a matrix, determine characteristic equation, eigenvalues and eigenvectors and diagonalizable of a matrix..	3	S
CO3	Students will learn to solve systems of linear equations and application problems, work with vector spaces and subspaces.	2	S
CO4	Students will be able to understand quadratic equations, cubic equation and biquadrate equation and higher power equation.	3	Enp
CO5	Students will be to solve the quadratic equations, cubic equation and biquadrate equation and higher power equation by easy method (cordon Method, Ferrari's Methods Descartes Method)	3	None

CO-PO Mapping forMA3106

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	3	2	1	3	1	3	2	3	2	1	2	2	2	2	2
CO 2	2	3	2	2	2	2	1	2	2	1	1	2	1	1	2
CO 3	1	1	2	3	1	2	2	2	1	3	1	2	2	1	1
CO 4	2	2	3	1	2	1	3	1	3	2	3	3	3	2	2
CO 5	3	3	2	2	2	2	3	2	1	3	2	2	1	1	2
Avg	2.2	2.2	2.0	2.2	1.6	2.0	2.2	2.0	1.8	2.0	1.8	2.2	1.8	1.4	1.8

SEMESTER 2

CS3202	**Title: Fundamental of Computer &Programming in C**	**L T P C** **3 0 0 3**
Version No.	1.0	
Course Prerequisites	Nil	
Objective	This subjects aims to make student handy with the computers basics and programming	
Expected Outcome	On completion of subject the students will be able to apply, Fundamental of Computers ,Architecture of Computer Arithmetic of Computer, Basics of Computer Programming	
Unit No.	**Unit Title**	**No. of Hrs (Per Unit)**
Unit 1	**Architecture of Computer**	**7**
What is Computer: Brief History and Evolution Chain, Concept of Hardware, The Inside Computer [Hard Drives (HD), Solid State Drives (SSD), Concept of CPU, Concept Of RAM, The Peripherals [Input Devices: Keyboard, Mouse, Media Devices [Floppy, DVD ROM, CD ROM, USB Storage Drive], Scanner], Output Devices [Monitor, Printer, Speaker		
Unit 2	**Arithmetic of Computer**	**7**
Number System [Decimal, Binary, Octal, Hexadecimal], Conversions, Binary Arithmetic [Addition, Subtraction, Multiplication, Division, 1s Compliment, 2s Compliment], Floating Point Arithmetic [IEEE 754 Concept, Storage of Floating Point Numbers]		
Unit 3	**Algorithms & Flow Chart**	**6**
Algorithm [What is Algorithm? Algorithm Writing Examples] Flow Chart [What is Flow Chart? Flow Chart Symbols, How to make Flow Chart? Types of Flow Chart, Flow Chart Examples]		
Unit 4	**Basics of C Programming –Part 1**	**9**
Types of Computer Languages:-Machine Language, Assembly Language and High Level Language, Concept of Compiler, Assembler, Linker and Loader. Fundamental Data Type: int, float, char and void. Qualifier for int (long and short), singed and unsigned numbers. Program vs. Process, Storage Classes: auto, static, extern and register. Operator vs. Operand. Operators: Arithmetic, Relational, Conditional and Logical		
Unit 5	**Basics of C Programming – Part 2**	**7**
Functions: Introduction [Function Definition, Declaration and Call], Types of Functions, Basic Programs, Recursive Function. Arrays: Introduction, Array Notation and Representation, Basic Programs, Types of Arrays [1-D, 2-D and n-D Array]. Pointer: Introduction, Declaration, Initialization and Access of data using pointer		
Text Books	1."Mastering C" by KR Venugopal 2."Let us C" by Y. kanetkar 3."Programming in ANSI C" by E. Balagurusamy.	
Reference Books	1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Pearson Education 2. Byron S Gottfried, " Programming with C", Schaum's Outlines Tata McGraw-Hill,	
Mode of Evaluation	Internal and External Examinations	
Recommended by Board of Studied on	07-06-2018	
Date of Approval by the Academic Council on	13-07-2018	

Course Outcome for CS3202

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will gain knowledge on programming and write pseudo-code.	1	S
CO2	Students will be able to choose the right data representation formats based on the requirements of the problem.	2	En
CO3	Students will be able to use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand.	2	S
CO4	Students will be able to write the program on a computer, edit, compile, debug, correct, recompile and run it.	3	En
CO5	Students will be able to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.	3	En

CO-PO Mapping for CS3202

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	1	2	2	3	2	1	3	2	1	1
CO 2	2	2	3	3	2	1	2	3	2	3	3	2	3	2	2
CO 3	2	3	2	2	2	2	3	2	1	2	3	2	2	3	2
CO 4	2	2	1	2	3	2	2	2	3	2	2	3	3	2	1
CO 5	3	2	2	2	1	3	2	2	2	3	2	1	2	3	1
Avg	2.2	2.2	2.0	2.2	2.0	1.8	2.2	2.2	2.2	2.4	2.2	2.2	2.4	2.2	1.4

PH3206	Title: Electricity and Magnetism	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To study basic of electromagnetic	
Expected Outcome	Students will be able to understand the basic phenomenon of electricity and magnetism.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Electric Field and Electric Potential	11
Electric field : Electric field lines, Electric flux, Gauss's Law with applications to charge distributions With spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential Laplace's Potential And Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to :(1) Plane Infinite Sheet and (2)Sphere.		
Unit II	Dielectric Properties of Matter	7
Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics.		
Unit III	Magnetic Field	7
Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole).Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.		
Unit IV	Magnetic Properties of Matter& Electromagnetic Induction	5
Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current		
Unit V	Electrical Circuits & Network theorems	6
. AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit Ideal constant-voltage and constant-current Sources. Review of Kirchhoff's Current Law & Kirchhoff's Voltage Law. Mesh & Node Analysis. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem. Applications to dc circuits.		
Text Books	1. S. Mahajan and Choudhury Electricity, Magnetism &Electromagnetic Theory, , Tata Mc Graw	
Reference Books	1. EdwardM.Purcell, ElectricityandMagnetism,,McGraw-HillEducation 2. D.J.Griffiths,IntroductiontoElectrodynamics, BenjaminCummings. 3. R.P.Feynman,R.B.Leighton,M.Sands,FeynmanLecturesVol.2,,PearsonEducation.. 4. J.H.Fewkes&J.Yarwood, ElectricityandMagnetism, Vol.I, OxfordUniv.Press.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval	13-07-2018	

by the Academic Council	

Course Outcome for PH3206

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to demonstrate Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. Apply Gauss's law of electrostatics to solve a variety of problems.	2	S
CO2	Students will gain knowledge on electric current, resistance and capacitance in terms of electric field and electric potential. Demonstrate a working understanding of capacitors.	2	S
CO3	Students will be able to describe the magnetic field produced by magnetic dipoles and electric currents. Also list examples where its effects are observed.	3	S
CO4	Students will be able to explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields. Also give basic understanding of magnetic properties of matter.	2	S
CO5	Students will be able to apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor. They will be also able to apply various network theorems such as Superposition Theorem, Thevenin Theorem, Norton Theorem, Reciprocity Theorem, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	3	S

CO-PO Mapping for PH3206

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	1	2	3	2	2	2	3	1	2	2
CO 2	1	2	2	2	2	1	1	3	2	1	2	2	1	2	3
CO 3	1	2	2	2	2	1	1	1	1	1	2	2	2	3	2
CO 4	2	2	2	3	3	1	1	1	1	1	2	2	1	3	2
CO 5	2	2	2	3	3	1	1	1	1	1	2	2	1	2	2
Avg	1.6	2.0	2.0	2.4	2.4	1.0	1.2	1.8	1.4	1.2	2.0	2.2	1.2	2.4	2.2

CY3206	Title: Thermodynamics & its Applications	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The aim of this paper is to expose the students with the knowledge in Heat and thermodynamics	
Expected Outcome	Understand the basic concepts of thermal conductivity and apply the basic thermodynamic properties.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Laws of thermodynamics	8
First law: Concept of heat, *q*, work, *w*, internal energy *U* and statement of first law; enthalpy, *H*, relation between heat capacities. *Second Law:* Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes. *Third Law:* Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.		
Unit II	Thermo chemistry	8
Heat of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermo chemical data, effect of temperature (Kirchoff's equations) and pressure on enthalpy of reactions. *Free Energy Functions:* Gibbs and Helmholtz energy; variation of *S*, *G*, *A* with*T*, *V*, *P*; Free energy change and spontaneity.		
Unit III	System of variable composition	6
Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Durham equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.		
Unit IV	Chemical Equilibrium	8
Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants *Kp, Kc*and*Kx*. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.		
Unit V	Solution &Collagative properties	6
Dilute solutions; lowering of vapor pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapor pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal dissociated and associated solutes in solution.		
Text Books	1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press.	
Reference Books	1. Engel, T. & Reid, P. *Thermodynamics, Statistical Thermodynamics, & Kinetics* Pearson Education, Inc: New Delhi. 2. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi.	
Modeof Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3206

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be learn the different laws of thermodynamics.	2	Em
CO2	Students will be gaining knowledge on thermo chemistry.	2	S
CO3	Students will be gaining knowledge on system of variable composition.	1	S
CO4	Students will be gaining knowledge on chemical equilibrium.	2	En
CO5	Students will be gaining knowledge on solutions and collagative properties.	1	None

CO-PO Mapping for CY3206

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	0	1	2	2	2	1	1	3	0	1	1
CO 2	1	1	2	1	2	1	1	2	3	2	1	2	0	2	2
CO 3	2	1	2	2	1	2	1	3	3	1	2	3	0	1	1
CO 4	1	2	1	1	0	1	2	2	2	2	1	2	0	2	1
CO 5	1	1	2	1	2	1	1	2	2	1	1	2	0	1	2
Avg	1.4	1.2	1.6	1.2	1.0	1.2	1.4	2.2	2.4	1.4	1.2	2.4	0.0	1.4	1.4

MA3207	Title: Differential Equations	L T P C 3 2 0 4
Version No.	1.1	
Course Prerequisites	MA3107	
Objectives	To introduce the theoretical concepts of ordinary differential equations	
Expected Outcome	Students will be familiar with various methods that lead to solving ODEs	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	First Order Differential Equations	8
Introduction, Solution of First order differential Equations of First degree and Higher degree		
Unit II	Second Order differential Equations with Constant Coefficient	6
Introduction, Complementary Function and Particular Integral, Solution of equations		
Unit III	Second order differential Equations with Variable Coefficient	8
Cauchy Euler homogeneous linear differential equations, Legendre's homogeneous equations, Method of reduction, Normal Form, Changing the Independent variable, Method of Variation of Parameters		
Unit IV	Simultaneous equations and Total differentiation	6
Solution of Simultaneous equations and Simple problems on Total Differential equation		
Unit V	Special Functions	8
Legendre polynomial and Bessel functions (Recurrence formulae, generating functions and some other properties).		
Text Books	1. R.K.. Jain and S R K Iyengar, Advance Engineering Mathematics, Narosa publication 2. M.D Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publication	
Reference Books	1. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad. 2. S. BalachandraRao& H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad 3. R.S. Senger, Ordinary Differential Equations with Integration, Prayal Publ. 4. D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India) 5. E.A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall of India 6. B.Rai, D.P.Choudhary,Ordinary Differential Equations, Narosa Publ.	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of Approval by the Academic Council	13-07-2018	

Course Outcome for MA3207

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn to solve the linear ordinary differential equation of first order and also learn the standard methods of solving the DE of first order and first degree.	3	S
CO2	Students will learn to solve the second order DE with constant coefficient and know the different methods of finding CF and PI.	2	S
CO3	Students will learn to solve the second order DE with variable coefficient by different methods like Cauchy Euler homogeneous linear DE,Legendre's homogeneous equation etc.	3	S
CO4	Students will gain knowledge about simultaneous equation and total differentiation.	2	S
CO5	Students will learn about some special functions (Legendre polynomial and Bessel functions) and their properties	3	S

CO-PO Mapping for MA3207

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	1	2	2	2	1	2	3	2	1	1	3	2	2	1
CO 2	2	1	1	1	2	2	1	1	2	1	2	2	2	1	1
CO 3	3	2	2	3	2	1	2	2	2	2	1	2	2	2	2
CO 4	2	3	2	2	3	2	1	2	3	1	2	3	2	2	3
CO 5	1	2	2	2	1	2	1	2	1	1	2	3	2	2	2
Avg	2	1.8	1.8	2	2	1.6	1.4	2	2	1.2	1.6	2.6	2	1.8	1.8

PH3240	Title: Electricity and Magnetism Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Learning objectives is to improve confidence in the behavior of electricity and magnetism in our daily life.	
Expected Outcome	To learn and practice the basic concept of magnetism practically.	

List of Experiments

At least 6 experiments from the following

1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self inductance of a coil by Anderson's bridge.
9. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
10. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
11. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

Text Books	
Reference Books	1. B.L. Flint and H.T. Worsnop, Advanced Practical Physics for students, Asia Publishing House 2. I.Prakash&Ramakrishna, A Text Book of Practical Physics, 11th Ed., Kitab Mahal 3. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, 4th Edition, reprinted , Heinemann Educational Publishers 4. S.Panigrahi and B.Mallick, Engineering Practical Physics, Cengage Learning.
Mode of Evaluation	Internal and External Examination
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3240

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn and practice the basic concepts of magnetism physically.	2	S
CO2	Students will be able to measure the field strength and verify the theorems.	3	S
CO3	Students will gain knowledge on response curve and able to determine high resistance and self and mutual inductance by different methods.	2	S

CO-PO Mapping for PH3240

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	2	2	3	2	3	2	3	2	2	2
CO 2	3	3	2	2	2	2	2	3	2	3	2	3	2	3	3
CO 3	3	3	2	2	2	2	2	3	2	3	2	3	2	2	2
Avg	3.0	3.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	2.3	2.3

CS3241	Title: Fundamental of Computers & Programming In C Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Learning objectives is to improve confidence in technology use an increased awareness of opportunities afforded to individuals with computer application skills.	
Expected Outcome	To learn and practice the basic concept of C language	

List of Experiments

1. Programs using I/O statements and expressions.
2. . Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Populate an array with height of persons and find how many persons are above the average height.
7. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
8. Given a string —a$bcd./fg‖ find its reverse without changing the position of special characters. (Example input:a@gh%;j and output:j@hg%;a)
9. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
10. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	07-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CS3241

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn a programming language.	2	Em
CO2	Students will learn problem solving techniques.	2	S
CO3	Students will be able to write programs in C and to solve the problems.	3	S

CO-PO Mapping for CS3241

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	3	1	2	2	2	2	1	2	1	2	2
CO 2	2	3	2	3	2	2	2	2	3	2	2	1	2	3	1
CO 3	1	2	2	2	2	3	1	2	2	3	2	2	2	2	2
Avg	2.0	2.3	2.3	2.3	2.3	2.0	1.7	2.0	2.3	2.3	1.7	1.7	1.7	2.3	1.7

CE3201	Title: Disaster Management*	L T P C 2 0 0 2*
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide a general concept in the dimensions of disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.	
Expected Outcome	Enhance the knowledge by providing existing models in risk reduction strategies to prevent major causalities during disaster.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit: 1	Introduction on Disaster	5
Different Types of Disaster : A) Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc B) Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc. Causes, effects and practical examples for all disasters.		
Unit II	Risk and Vulnerability Analysis	4
Risk : Its concept and analysis 2. Risk Reduction 3. Vulnerability : Its concept and analysis 4. Strategic Development for Vulnerability Reduction		
Unit III	Disaster Preparedness	5
Disaster Preparedness: Concept and Nature . Disaster Preparedness Plan Prediction, Early Warnings and Safety Measures of Disaster. Role of Information, Education, Communication, and Training, . Role of Government, International and NGO Bodies. . Role of IT in Disaster Preparedness . Role of Engineers on Disaster Management.		
Unit IV	Disaster Response	5
Introduction Disaster Response Plan Communication, Participation, and Activation of Emergency Preparedness Plan Search, Rescue, Evacuation and Logistic Management Role of Government, International and NGO Bodies Psychological Response and Management (Trauma, Stress, Rumor and Panic). Relief and Recovery Medical Health Response to Different Disasters		
Unit V	Rehabilitation, Reconstruction and Recovery	5
Reconstruction and Rehabilitation as a Means of Development. Damage Assessment Post Disaster effects and Remedial Measures. Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction Sanitation and Hygiene Education and Awareness, Dealing with Victims' Psychology, Long-term Counter Disaster Planning Role of Educational Institute.		
Text Books	1.Disaster Science and Management by Bhattacharya published in McGraw Hill Education (India) Pvt. Ltd.	
Reference Books	1.Disaster Management by Dr. Mrinalini Pandey published in Wiley India Pvt. Ltd. Tushar 2.Disaster Management : Future Challenges and Opportunities by Jagbir Singh published in K W Publishers Pvt.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CE3201

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students can be able to correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and preventions.	2	S
CO2	Students should be able to understand the solutions related to environmental problems related with the renewable & non-renewable resources.	2	S
CO3	Students should be able to understand the importance of ecosystem and biodiversity and the method of conservation of biological diversity.	2	S
CO4	Students should be able to understand different components of the environment and their function and the effects pollution on environment and should be able to understand the concept of sustainable development.	2	S
CO5	Students should be able to correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and preventions.	2	S

CO-PO Mapping for CE3201

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	2	1	1	1	0	1	1	2	2	1	2	2	1	2	2
CO 2	2	2	1	2	0	2	2	2	3	1	3	1	3	2	3
CO 3	2	2	2	1	1	1	3	2	2	1	2	2	2	2	3
CO 4	2	2	1	2	1	2	2	2	2	1	3	1	2	2	2
CO 5	2	2	1	2	1	2	1	3	2	1	1	2	1	2	2
Avg	2.0	1.8	1.2	2.0	0.6	2.0	3.0	2.2	2.2	1.0	3.0	2.0	3.0	2.0	2.4

PH3207	Title: Waves and Optics	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To study the basic phenomenon of Wave motion and light and its properties	
Expected Outcome	Students will be able to understand the wave motion of oscillators and light and its impact on our daily life	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Superposition of Collinear Harmonic oscillations and two perpendicular Harmonic Oscillations	5
Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats).		
Unit II	Wave Motion	5
Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Energy Transport. Intensity of Wave.		
Unit III	Superposition of Two Harmonic Waves	8
Standing (Stationary) Waves in a String: Fixed and Free Ends. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Pressure of a Longitudinal Wave. Open and Closed Pipes. Phase and Group Velocities. Superposition of N Harmonic Waves.		
Unit IV	Wave Optics, Interference	7
Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment.		
Unit V	Interferometer and Diffraction and Polarization	11
Michelson Interferometer-Basics, Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Resolving Power of a telescope.Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate Polarization, Brewster's Law, Birefringence, Ordinary and Extraordinary Rays, Nicol Prism, Wave plates and Polarimeter		
Text Books	1. AjoyGhatak, Optics, Tata McGraw Hill	
Reference Books	1. Francis Crawford, Waves: Berkeley Physics Course, vol. 3, Tata McGraw-Hill. 2. F.A. Jenkins and H.E. White,Fundamentals of Optics, McGraw-Hill 3. Max Born and Emil Wolf, Principles of Optics, Pergamon Press. 4. H. J. Pain,The Physics of Vibrations and Waves, John Wiley and Sons. 5. N.K. Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill. 6. A. Kumar, H.R. Gulati and D.R. Khanna,Fundamental of Optics, R. ChandPublications	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3208

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to understand the principle of superposition of waves, so thus describe the formation of standing waves.	2	S
CO2	Students will be able to understand about wave phenomenon and various properties describing wave motion.	2	S
CO3	Students will be able to recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.	3	S
CO4	Students will be able to use the principles of wave motion and superposition to explain the physics of interference and understand the working of selected optical instruments like biprism.	2	S
CO5	Students will be able to use the principles of wave motion and superposition to explain the physics of polarisation, interference and diffraction and understand the working of selected optical instruments like interferometer, diffraction grating and polarimeter,	3	S

CO-PO Mapping for PH3208

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	3	2	2	2	3	2	1	2	1	2	1	1	2	1	2
CO 2	2	2	2	2	2	2	2	2	2	2	1	3	1	2	1
CO 3	3	1	3	2	3	2	1	3	1	2	1	3	2	2	1
CO 4	3	2	2	1	2	2	2	1	2	2	1	2	1	3	3
CO 5	2	1	2	2	2	2	1	2	2	2	1	3	1	3	2
Avg	2.6	1.6	2.2	1.8	2.4	2.0	1.4	2.0	1.6	2.0	1.0	2.4	1.4	2.2	1.8

CY3207	Title: s & p block elements	L T P C 4 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To acquire knowledge about properties of inorganic compounds	
Expected Outcome	It will provide better understanding about structure and properties of halogens, noble gasses and inorganic polymers	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Chemistry of s & p block elements	8
Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.		
Unit II	Structure & properties of Inorganic Compounds	7
Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds,		
Unit III	Halogens	7
silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudo halogens and basic properties of halogens.		
Unit IV	Noble Gasses	7
Occurrence & uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2 and XeF4, XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).		
Unit V	Inorganic polymers	7
Types of inorganic polymers, comparison with organic polymers, synthesis, structuralaspects and applications of silicones and siloxanes. Borazines, silicates andphosphazenes, and polysulphates.		
Text Books	1. Cotton, F.A. and Wilkinson, G, *Advanced Inorganic Chemistry*, Wiley, VCH.	
Reference Books	1. Greenwood, N.N. and Earnshaw, *Chemistry of the Elements*, Butterworth-Heinemann. 2. Lee, J.D. *Concise Inorganic Chemistry*, ELBS 3. Canham, G.R. and Overton, T., *Descriptive Inorganic Chemistry*, Freeman &Co.	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3207

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students able to know the structures, properties, application and the chemical reactivity of the s&p block	2	S
CO2	Students will learn the fundamental of chemistry of the main group elements, and importance and real world application of many of these elements	2	En
CO3	Students will be able to describe the occurrence, preparation and characteristics of halogens.	2	S
CO4	Students will be able to describe to properties, preparation and uses of noble gas	2	S
CO5	Students will gain knowledge on polymers, their synthesis, reaction, mechanism and kinetics	2	None

CO-PO Mapping for CY3207

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	1	1	1	1	1	2	1	2	1	1	1	1
CO 2	1	1	2	2	1	1	2	1	2	1	1	2	1	1	2
CO 3	1	1	2	1	1	1	1	1	1	1	2	1	2	1	2
CO 4	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1
CO 5	1	1	1	1	2	2	2	1	1	1	1	1	2	1	1
Avg	1.0	1.0	1.8	1.4	1.4	1.4	1.4	1.0	1.4	1.0	1.4	1.2	1.4	1.0	1.4

CY3242	Title: Thermo Chemistry Lab	L T P C 0 0 2 1
Version No.	1.1	
Course Prerequisites		
Objectives	To determine heat capacity of calorimeter using standard methods.	
Expected Outcome	To learn methods to calculate enthalpy change of different solutions	
Exp No	Exp Title	

1. Demonstration of Bomb Calorimeter

2. Determination of Heat capacity of the calorimeter and enthalpy of neutralization of Hydrochloric acid with Sodium Hydroxide.

3. Calculation of the Enthalpy of Ionization of Ethanoic acid.

4. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts
5. To determine Heat of solution of a given salt in water by calorimeter

6. To determine Heat of hydration of anhydrous Copper Sulphate .

Text Books	Reference text: 1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
Reference Books	
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	31-03-2018
Date of approval by the Academic Council	11-06-2018

Course Outcome for CY3242

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain knowledge on working principle of Bomb Calorimeter.	2	Emp
CO2	Students will be able to determine the heat capacity of calorimeter using standard methods.	2	S
CO3	Students will learn to calculate enthalpy change of different solution.	3	S

CO-PO Mapping for CY3242

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
Avg	1.0	1.0	1.7	1.3	1.3	1.0	1.0	1.3	1.3	2.0	1.3	1.3	1.0	1.0	1.7

MA3206	**Title: Solid Geometry and Vector Calculus**	**L T P C** **3 0 0 3**
Version No.	**1.0**	
Course Prerequisites	MA3107	
Objectives	To impart the knowledge of geometry and vector calculus .	
Expected Outcome	Students will be able to Do basic 2- and 3-D plotting.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Direction Cosines and Projection**	5
System of Coordinates, Direction Cosines and Projections.		
Unit II	**Plane and straight line**	4
The Plane, Straight line.		
Unit III	**3-D shapes**	6
The Sphere, The cylinder, The Cone.		
Unit IV	**Line and surface integral**	5
Vector differentiation and integration, Gradient, divergence and curl and their properties, Line integrals, surface integral , Volume Integral.		
Unit V	**Theorems based on vector integration**	4
Green's Theorem, Stokes and Gauss theorem and problems based on these theorems.		
Text Books	1. A. R. Vasishtha, Geometry(2D&3D), Krishna publication 2. A. R. Vasishtha and D. C. Agarwal, Vector Calculus, Krishna publication	
Reference Books	1.G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, Delhi. 2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi. 3. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad. 4. Shanti Narayan and P.K. Mittal, A text book of Vector Calculus, S. Chand Publication	
Mode of Evaluation	Internal and External Examination	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3206

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Student will learn to find the position of any partical in the space, find the areas of triangles, quadrilaterals and circles and shapes.	2	Emp
CO2	Students will gain knowledge on concepts: plane; points; lines; line segments; i rays and length of (straight) line,	3	S
CO3	Students will understand the concepts of advance topics related to two and three dimensional geometry and learn the application of sphere, cone and cylinder and understand geometrical terminology for angles, triangles, quadrilaterals and circles.	3	S
CO4	Students will gain knowledge on directional derivative and gradient and wiil be able to illustrate geometric meanings with the aid of sketches.	3	Enp
CO5	Students will be able to understood the relation between gard ,Div,and Curl Apply gradient to solveproblems involving normal vectors to level surfaces. Explain the concept of a vector integration a plane and in space.	3	S

CO-PO Mapping for MA3206

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	2	3	3	1	2	3	2	1	3	1	3	2
CO 2	3	1	3	2	3	3	1	2	3	2	1	1	2	3	2
CO 3	2	3	3	1	3	2	3	2	1	2	3	3	3	1	3
CO 4	1	3	2	2	3	3	1	2	3	2	3	2	3	2	1
CO 5	3	2	1	3	2	3	2	3	1	3	2	3	3	3	2
Avg	2.2	2.0	2.4	2.0	2.8	2.8	1.6	2.2	2.2	2.2	2.0	2.4	2.4	2.4	2.0

CY3242	Title: Thermo Chemistry Lab	L T P C 0 0 2 1
Version No.	1.1	
Course Prerequisites		
Objectives	To determine heat capacity of calorimeter using standard methods.	
Expected Outcome	To learn methods to calculate enthalpy change of different solutions	
Exp No	Exp Title	

1. Demonstration of Bomb Calorimeter

2. Determination of Heat capacity of the calorimeter and enthalpy of neutralization of Hydrochloric acid with Sodium Hydroxide.

3. Calculation of the Enthalpy of Ionization of Ethanoic acid.

4. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts

5. To determine Heat of solution of a given salt in water by calorimeter

6. To determine Heat of hydration of anhydrous Copper Sulphate .

Text Books	Reference text: 1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
Reference Books	
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	31-03-2018
Date of approval by the Academic Council	11-06-2018

Course Outcome for CY3242

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain knowledge on working principle of Bomb Calorimeter.	2	Emp
CO2	Students will be able to determine the heat capacity of calorimeter using standard methods.	2	S
CO3	Students will learn to calculate enthalpy change of different solution.	3	S

CO-PO Mapping for CY3242

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
Avg	1.0	1.0	1.7	1.3	1.3	1.0	1.0	1.3	1.3	2.0	1.3	1.3	1.0	1.0	1.7

SEMESTER 3

PH3306	Title: Elements of Modern Physics	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide an overview of quantum wave mechanics and radioactivity.	
Expected Outcome	Students will be able to understand concepts relevant in modern physics and appreciate the advances in physics	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Planck's Quantum, Planck's Constant and Light as a Collection of Photons; Blackbody Radiation	8
Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocitiesand relation between them. Wave amplitude and wave functions.		
Unit II	Position Measurement	6
Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables), Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range ofan interaction.		
Unit III	Quantum Wave Mechanics	10
Two slit interference experiment with photons, atoms and particles; linear superposition principleas a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension. One dimensional in finitely rigid box- energy eigen values and Eigen functions, normalization; Quantum dot as example; Quantum mechanical scattering and tunneling in one dimension-across a step potential & rectangular potential barrier.		
Unit IV	Atom and Nucleus	7
Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy		
Unit V	Radioactivity	5
Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.		
Text Books	1. R Murugeshan , KiruthigaSivaprasath, Modern Physics, S. Chand Publications	
Reference Books	1. Arthur Beiser, Concepts of Modern Physics McGraw-Hill. 2. Rich Meyer, Kennard, Coop, Introduction to Modern Physics, Tata McGraw Hill 3. David J. Griffith, Introduction to Quantum Mechanics, Pearson Education. 4. Jewett and Serway, Physics for scientists and Engineers with Modern Physics, Cengage Learning. 5. G.Kaur and G.R. Pickrell, Modern Physics, McGraw Hill 6. R. Gautreau and W. Savin, Theory and Problems of Modern Physics, Schaum`s outline, Tata McGraw-Hill Publishing Co. Ltd. 7. E.H. Wichman, Quantum Physics, Berkeley Physics, Vol.4. Tata McGraw-Hill Co. 8. T. A. Moore,Six Ideas that Shaped Physics:Particle Behave like Waves, McGraw Hill	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	

Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3306

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to understand the basic concept of quantum wave mechanics and black body radiation	2	S
CO2	Students will learn about the wave nature of light and Heisenberg principle and its application.	2	S
CO3	Students will be able to explain fundamentals of quantum mechanics and apply it to problems on bound states.	3	S
CO4	Students will gain the knowledge about the basic of atom and nucleus.	2	S
CO5	Students will have an overview of radioactivity.	2	S

CO-PO Mapping for PH3306

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	3	3	1	2	2	1	2	1	1	1	2	2	2
CO 2	2	3	3	1	3	2	1	1	2	1	1	3	3	3	1
CO 3	3	2	2	3	2	1	2	3	2	2	2	2	2	2	2
CO 4	3	3	2	3	1	2	2	3	2	3	1	3	1	3	2
CO 5	3	3	2	2	3	2	1	2	3	1	2	3	2	2	3
Avg	2.4	2.6	2.4	2.4	2.0	1.8	1.6	2.0	2.2	1.6	1.4	2.4	2.0	2.4	2.0

CY3308	Title: Spectroscopy	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	None	
Objectives	Spectroscopy is a collective term for scientific technique that investigate the interaction of matter with radiation	
Expected Outcome	Students will learn the important role of spectroscopy in the,structure of organic compounds.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Molecular Spectroscopy	5
Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bondlengths of diatomic and linear tri-atomic molecules, isotopic substitution.		
Unit II	Vibrational Spectroscopy	7
Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.		
Unit III	Photochemistry	7
Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photo chemical reactions in biochemical processes, photostationary		
Unit IV	NMR Spectroscopy	5
Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. Electron Spin Resonance (ESR) spectroscopy.		
Unit V	Electronic spectroscopy	5
Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and pre dissociation, calculation of electronic transitions of polyenes using free electron model.		
Text Books	1. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press .	
Reference Books	1. Banwell, C. N. &McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. TataMcGraw-Hill: New Delhi 2. Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3308

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to know the working of various instruments.	2	S
CO2	Students will learn the interaction of electromagnetic radiations with molecules and various types of spectra.	2	S
CO3	Students will gain knowledge on the spectra and its uses to detect ,identify, and quantify information about the atoms and molecules.	2	S
CO4	Students able to know the physical, chemical and biological properties of matter.	2	S
CO5	Student will gain knowledge on Spectroscopy and its applications.	2	S

CO-PO Mapping for CY3308

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	1	1	2	3	2	1	1	1	0	2	2
CO 2	2	1	2	1	1	2	2	1	1	1	2	1	0	1	1
CO 3	1	1	1	1	2	1	3	2	2	1	1	1	0	2	1
CO 4	2	1	3	1	1	1	2	3	2	1	1	1	0	1	2
CO 5	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2
Avg	1.6	1.0	1.6	1.0	1.2	1.2	2.0	2.2	1.6	1.0	1.2	1.0	0.2	1.4	1.6

MA3308	Title: Statistical Techniques	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide the knowledge of Probability and Statistical Techniques with SPSS	
Expected Outcome	Students will be able to analyze and interpret statistical data using appropriate probability distributions	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	6
Introduction to Statistics; Moments; Skewness; Kurtosis		
Unit II	Correlation and Regression	8
Correlation; Coefficient of Correlation, Rank Correlation, Multiple correlation, Line of regression, Curve fitting, Multiple regression, Curve fitting by method of least squares, Time Series Analysis		
Unit III	Probability	6
Introduction, Definition and Examples of Random Experiment, Permutation and Combinations, Axioms of Probability, conditional probability, multiplication and addition theorem, Boole's Inequality, Bay's Theorem.		
Unit IV	Expectation and Moment Generating Function	8
Random Variables, Properties of Distribution Function, Definition and Examples of Expectation, Chebyshev's Theorem, Moment Generating Function,		
Unit V	Distributions	8
Discrete Distributions, Discrete Uniform Distribution, Binomial Distribution, Poisson Distribution, Continuous Distribution, Normal Distribution		
Text Books	1. Gupta, S.C., Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan publication.	
Reference Books	1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia 2. Irwin Miller and Marylees Miller, John E. Freund's Mathematical Statistics with Applications, Pearson Education, Asia 3. Sheldon Ross, Introduction to Probability Models, Academic Press,Indian Reprint	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3308

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis	2	S
CO2	Students will be able to establish the joint distribution of two random variables in terms their correlation and regression.	3	S
CO3	Students will be able to understand the basic concepts of probability.	3	S
CO4	Students will be able to solve a range of problems using the techniques covered	2	S
CO5	Students will be able to understand central limit theorem which shows that the empirical frequencies of so many natural populations exhibit normal distribution.	2	S

CO-PO Mapping for MA3308

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	2	2	1	3	2	3	1	2	3	3	1	2
CO 2	2	3	2	3	3	2	2	2	2	2	2	2	2	2	2
CO 3	3	2	3	3	1	1	2	3	2	2	3	2	3	2	3
CO 4	2	3	3	2	2	2	3	2	3	2	3	1	2	3	1
CO 5	2	2	2	3	2	1	1	2	2	1	2	3	1	3	2
Avg	2.0	2.4	2.4	2.6	2.0	1.4	2.2	2.2	2.4	1.6	2.4	2.2	2.2	2.2	2.0

PH3340	Title: **Elements of Modern Physics Lab**	**LTPC 0021**
Version No.	**1.0**	
Course Prerequisites	**Nil**	
Objectives	To provide the knowledge of recent modern advancements in quantum and relativistic physics experiments	
Expected Outcome	Students will be able to learn and practice modern physics experiments and appreciate the shortfall of classical mechanics in explaining certain phenomena.	

At least 06 experiments from following:

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colors
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine angular spread of He-Ne laser using plane diffraction grating

Text Books	
Reference Books	1. B.L. Flint and H.T.Worsnop, Advanced Practical Physics for students, Asia Publishing House 2. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, Heinemann Educational Publishers 3. I.Prakash& , Ramakrishna, A Text Book of Practical Physics, KitabMahal
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3340

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students should be able to measure Planck constant using black body radiation and photo detector	2	S
CO2	Students should be able to determine work function of material of filament of directly heated vacuum diode	2	S
CO3	Students should be able to determine the wavelength of laser source using diffraction of single slit and double slit.	2	S

CO-PO Mapping for PH3340

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	1	3	1	2	1	1	1	2	0	2	1
CO 2	1	2	1	1	2	2	1	2	2	2	1	3	0	1	1
CO 3	2	3	2	2	2	3	1	3	1	2	1	2	0	2	2
Avg	1.7	2.7	1.7	1.7	1.7	2.7	1.0	2.3	1.3	1.7	1.0	2.3	0.0	1.7	1.3

PH3307	Title: Mathematical Physics I	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites	MA3107, MA3207	
Objectives	The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.	
Expected Outcome	Students will be able to solve mathematical problems using Fourier series, partial differential equations and other mathematical functions relevant for physicists	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	**Vectors and Vector Spaces**	6
Vector calculus, Gradient, Divergence and Curl in curvilinear coordinates applications to Classical mechanics and electrodynamics. Linear independence, bases, orthogonality and completeness, linear operators, change of basis, similarity transformation, dual spaces		
Unit II	**Matrices**	5
Introduction, Matrix diagonalization, eigenvalues and eigenvectors, orthogonal and unitary matrices		
Unit III	**Partial Differential Equations and Complex analysis**:	8
Solutions to partial differential equations, using separation of variables: Solutionofwaveequationforvibrationalmodesofastretchedstring,Cauchy-Riemann conditions, analyticity, Cauchy-Goursat theorem, Cauchy's integral formula, branch points and branch cuts, multi valued functions, residue theorem, applications of residue theorem, Jordan's lemma, Taylor and Laurent series, Singularities and convergence, Conformal mapping and applications.		
Unit IV	**Fourier Series**	8
Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions. Applications of Fourier series.		
Unit V	**Special Functions**	11
Legendre Polynomial and Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x)) and Orthogonality. Dirac delta function, definitions and different representations of delta functions		
Text Books	1.H K Dass and Dr Rama Verma, Mathematical Physics, S Chand	
Reference Books	● Arfken, Weber, Harris, Mathematical Methods for Physicists, Elsevier. ● Schaum'sOutlineSeries, Tata McgrawHill ● M.R. Spiegel, Fourier Analysis, Tata McGraw-Hill. ● George F. Simmons, Differential Equations, Tata McGraw-Hill. ● S. Pal and S.C. Bhunia, Engineering Mathematics, Oxford University Press ● K.F. Riley, M.P. Hobson and S.J. Bence, *Mathematical Methods for Physics and Engineering,* Cambridge University Press ● T. Lawson, *Linear Algebra,* John Wiley and Sons ● R.V. Churchill. *Complex variables and applications,* Tata Mcgraw Hill ● A.W. Joshi, *Matrices and Tensors in Physics,* New Age	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic	13-07-2018	

Course Outcome for PH3307

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will gain knowledge on Vectors and Vector space and their properties.	2	S
CO2	Students will be able work with matrices and determine if a given square matrix is invertible and solve the given values and given vectors of a matrix and determine diagonalization of a matrix.	3	S
CO3	Students will gain knowledge on PDE and their solution by variable separable method and introduction on complex analysis and some important theorem on it ,Jordan lemma, Taylors and Laurents series , conformal mapping and application .	2	S
CO4	Student will learn about fourier series, perodic functions and their expansion even and odd function and their fourier expansion and application of fourier series.	3	S
CO5	Students will learn about some special functions (Legendre polynomial, Hermite and Bessel functions) and their properties.	2	S

CO-PO Mapping for PH3307

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	3	2	3	3	1	2	2	3	2	1	2	2	1	2	2
CO 2	2	3	3	1	3	2	1	2	2	1	1	3	1	3	3
CO 3	3	2	2	3	2	1	2	3	1	2	2	2	1	2	2
CO 4	3	3	2	3	1	2	2	2	2	1	2	3	1	3	1
CO 5	3	3	2	2	3	2	1	2	3	1	1	3	1	2	2
Avg	2.8	2.6	2.4	2.4	2.0	1.8	1.6	2.4	2.0	1.2	1.6	2.6	1.0	2.4	2.0

Specialization in Chemistry

CY3306	**Title: Co-ordination Chemistry**	**L T P C** **3 0 0 3**
Version No.	**1.0**	
Course Prerequisites	**Nil**	
Objectives	In chemistry coordination or metal complex consist of an atom or ion (usually metallic) and a surrounding array of bound molecule or anions known as ligands.	
Expected Outcome	Coordination compound has been studied extensively because Ofwhat they reveal about molecule structure & chemical bonding.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Coordination Chemistry**	7
Werner's theory, valence bond theory (inner and outer orbital complexes), electro neutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt).Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry.		
Unit II	**Stereochemistry & Nomenclature**	7
Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.		
Unit III	**Transition Elements**	6
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes.		
Unit IV	**Oxidation states of Transition elements**	7
Stability of various oxidation states and e.m.f. (Latimer &Bosworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy).		
Unit V	**Lanthanoids and Actinoids**	8
Electronic configuration, oxidation states, colour, spectral and magnetic properties lanthanide contraction, separation of lanthanides (ion-exchange method only).		
Text Books	1. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.:New Delhi .	
Reference Books	2. Peter Atkins & Julio De Paula, *Physical Chemistry 9th Ed.*, Oxford University Press. 3. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall . 4. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3306

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to know the structures, properties, application and the chemical reactivity.	2	S
CO2	Students will be able to coordinate compounds are used as catalysts for many applications in qualitative/quantitative chemical analysis within analytical chemistry.	1	S
CO3	Students will learn the interaction of metal and ligands	2	S
CO4	Students able to know the physical, chemical properties and structure of the metals.	2	En
CO5	Students able to know the magnetic and catalytic behavior of complex compounds	2	S

CO-PO Mapping for CY3306

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO 1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1
CO 2	1	2	1	1	1	1	2	1	2	1	2	1	1	1	2
CO 3	1	1	1	1	2	1	2	2	1	1	2	1	1	2	1
CO 4	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
CO 5	1	2	1	2	1	1	1	2	1	1	1	1	1	2	2
Avg	1.0	1.4	1.2	1.4	1.2	1.0	1.4	1.4	1.2	1.2	1.4	1.0	1.0	1.4	1.4

CY3343	Title: Quantitative Analysis Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites		
Objectives	To prepare the inorganic and organic compounds by various methods.	
Expected Outcome	Student will learn synthesis of different compounds	
Exp No	Experiment Title	

1.Quantitative Analysis: Estimation of copper as CuSCN
2.Inorganic Preparations

(i) Tetraammine Copper (II) Sulphate, [Cu(NH3)4]SO4 H2O

(ii) Potassium trisoxalatochromate (III), K3[Cr(C2O4)3]

3.Systematic analysis of extra elements in the given unknown compounds

4. Tests for following functional groups and unsaturation
    1. Qualitative analysis of the following types of unknown organic compounds

Carboxylic acids
Phenols
Alcohols
Aldehydes
Ketones
Esters

6.Determination of pK (indicator) for Phenolphthalein or Methyl red.

Text Books	1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.
Reference Books	Pandey, Bajpai, &Giri, "Practical Chemistry", S.Chand Publication.
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3343

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to know the preparation of inorganic and organic compound by various methods.	1	Emp
CO2	Students will learn the synthesis of different compound.	2	S
CO3	Students will able to apply the knowledge of various methods in industries.	3	S

CO-PO Mapping for MA3308

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	2	1	1	1	1	1	2	1	1	1	1
CO 2	1	1	1	2	2	1	2	1	1	2	2	2	2	2	1
CO 3	1	2	2	2	2	2	1	2	1	2	2	1	2	1	3
Avg	1.0	1.7	1.3	1.7	2.0	1.3	1.3	1.3	1.0	1.7	2.0	1.3	1.7	1.3	1.7

MA3306	Title: Real Analysis	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To impart the knowledge of real numbers and functions.	
Expected Outcome	Students will be able to describe the real line as a complete and will be able to Use the definitions of convergence	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Countability	8
Axiomatic study of real numbers, Completeness property in R, Countable and uncountable sets, Neighbourhood, Interior points, Limit points, Open and closed sets, Derived sets, Dense sets, Perfect sets, Bolzano-Weierstrass theorem.		
Unit II	Sequence	8
Sequences of real numbers, Sequence and its convergence (basic idea), Subsequences, Bounded and monotonic sequences, Convergent sequences, Cauchy's theorems on limit, Cauchy sequence, Cauchy's general principle of convergence, Uniform convergence of sequences of functions, Weierstrass M-test.		
Unit III	Infinite series	8
Convergence of infinite series, Comparison test, ratio test, root test, Raabe's test, Logarithmic ratio test, Cauchy's condensation test, Alternating series, Leibnitz test, Absolute and conditional convergence, Uniform convergence of series of functions.		
Unit IV	Continuity and Differentiability	6
Continuity of functions, Properties of continuous Functions, Types of discontinuities, Uniform Continuity, Differentiability, Mean value theorems, Taylor's theorem with various forms of remainders.		
Unit V	Riemann integral	6
Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Improper integrals and their convergence .		
Text Books	1. Mathematical Analysis-Savita and Arora (New age Publication) 2. Real Analysis -Robert G Bartle(Wiley Publication) 3. Methods of Real Analysis – RR GOLDBERG (Oxford and lbh)	
Reference Books	1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd., Singapore 2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis,2nd Ed., Jones & Bartlett 3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall 4. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3306

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will learn about the countable set and properties of countable set .	2	Emp
CO2	Students will learn about sequence and theorem based on sequence.	3	S
CO3	In this students will learn about convergence of positive term series and absolute term series .	3	S
CO4	In this students will learn about concept of continuity and differentiability .	3	Enp
CO5	Students will learn about rehman integrals and proof of theorems based on Rehman integrals .	3	None

CO-PO Mapping forMA3306

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	3	1	3	1	2	3	3	2	2	2	2	3	3	2
CO 2	2	2	2	3	1	2	3	3	2	2	2	2	3	3	1
CO 3	2	3	1	3	1	1	3	3	2	2	2	2	3	3	1
CO 4	2	3	1	3	1	2	3	3	2	2	2	2	3	3	2
CO 5	2	3	1	3	1	2	3	3	2	2	2	2	3	3	1
Avg	2.0	2.8	1.2	3.0	1.0	1.8	3.0	3.0	2.0	2.0	2.0	2.0	3.0	3.0	1.4

SEMESTER 4

PH3406	Title: Thermal Physics	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The course will serve as an introduction to Thermodynamics and Kinetic theory	
Expected Outcome	Students will have general background in thermodynamics	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Zeroth and First Law of Thermodynamics	8
Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law and various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.		
Unit II	Second Law of Thermodynamics	9
Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.		
Unit III	Entropy	7
Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.		
Unit IV	Thermodynamic Potentials	6
Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, ClausiusClapeyron Equation and Ehrenfest equations.		
Unit V	Maxwell's Thermodynamic Relations	6
Derivation of Maxwell's thermodynamic Relations and their applications, Maxwell's Relations: (1) ClausiusClapeyron equation, (2) Value of C_p-C_v, (3) Tds Equations, (4) Energy equations.		
Text Books	1. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill	
Reference Books	1.M.W. Zemansky, Richard Dittman, Heat and Thermodynamics, Tata McGraw-Hill. 2. Sears & Salinger. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Narosa. 3.A. Kumar and S.P. Taneja, Thermal Physics, R. Chand Publications	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3406

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn about the zeroth and first law of thermodynamics and their applications.	1	S
CO2	Students will learn about the second law of thermodynamics and should be able to use it in various applications.	2	S
CO3	Students will be able to understand the concepts of entropy and third law of thermodynamics and their applications.	2	S
CO4	Students will gain knowledge about various thermodynamics potential function and should be able to find the relation between them	3	S
CO5	Students will learn about the Maxwell's thermodynamics relation and their applications.	3	S

CO-PO Mapping for PH3406

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	2	2	3	3	1	2	2	1	2	1	2	1	1	2	1
CO 2	2	3	3	1	3	2	1	1	2	1	2	3	1	3	2
CO 3	3	2	2	3	2	1	2	2	1	2	3	2	2	2	2
CO 4	3	3	2	3	1	2	2	3	2	3	2	3	1	3	3
CO 5	3	3	2	2	3	2	1	2	3	1	2	3	2	2	2
Avg	2.8	2.6	2.4	2.4	2.0	1.8	1.6	1.8	2.0	1.6	2.2	2.4	1.4	2.4	2.0

CY3406	**Title: Basics and Hydrocarbons**	**L T P C** **3 0 0 3**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	To provide knowledge about synthesis of organic compounds	
Expected Outcome	Learning preparation and reaction chemistry of aliphatic and aromatic phenols, ethers and carbonyl compounds	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Basics of Hydrocarbon**	8
Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules,Influence of hybridization on bond properties.Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relativestrength. Homolytic and Heterolytic fission with suitable examples.		
Unit II	**Steriochemistry**	8
Fischer Projection, Newmann and Sawhorse Projection formulae and their inter conversions, Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.Prules.Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers,Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixtureand resolution. Relative and absolute configuration: D/L and R/S designations		
Unit III	**Chemistry of Aliphatic Hydrocarbon**	10
A. Carbon-Carbon sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Freeradical substitutions: Halogenation - relative reactivity and selectivity. **B. Carbon-Carbon pi bonds** Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ AntiMarkownikoff addition),		
Unit IV	**Cycloalkanes &Conformational analysis**	6
Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis ofalkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms;Relative stability with energy diagrams.		
Unit V	**Aromatic Hydrocarbon**	6
Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanionsandheterocyclic compounds with suitable examples. Electrophilic aromatic substitution:halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with theirmechanism. Directing effects of the groups.		
Text Books	1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).	
Reference Books	2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd.(PearsonEducation). 3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3406

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to know the structure of compounds and properties.	1	S
CO2	Students will be able to describe the Steriochemistry of molecules and its properties.	2	S
CO3	Students will be able to know the structure of aliphatic compounds	1	S
CO4	Students will gain knowledge on conformational analysis of Cyckloalkanes.	2	S
CO5	Students will be able to know the characteristics of organic compounds.	1	None

CO-PO Mapping for CY3406

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	1	2	1	1	1	1	1	1	2	1	0	1	1
CO 2	1	1	2	1	2	1	2	2	1	1	1	1	0	2	1
CO 3	1	1	1	2	1	2	1	2	3	1	1	2	0	1	2
CO 4	2	2	1	1	2	1	1	1	2	1	1	1	0	1	1
CO 5	1	1	1	1	1	2	2	2	2	1	1	1	0	1	1
Avg	1.2	1.4	1.2	1.4	1.4	1.4	1.4	1.6	1.8	1.0	1.2	1.2	0.0	1.2	1.2

MA3406	**Title: Numerical Analysis**	**L T P C** **3 0 0 3**
Version No.	**1.0**	
Course Prerequisites	**Nil**	
Objectives	To impart knowledge of numerical analysis in solving differential equations using software	
Expected Outcome	Students will be able to identify algorithms with which to solve mathematical problems, and write programs	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Error, Transcendental and Polynomial equations**	8
Accuracy of Numbers, Numbers in Numerical Computation, Floating Point Representation of Numbers, Stability of Algorithm, Errors in Numerical Computation, Error Propagation, General Error Formula, Iterative methods, Initial Approximations, Bisection Method, Regulafalsi method (Secant Method), Newton-Raphson Method, Rate of Convergence		
Unit II	**Numerical Solutions of Algebraic Equations: Direct and Iterative**	8
Direct Methods to Solve the System of Linear Equations, Method of Factorization (Triangularization Method), ,Crout's method, Cholesky Method, Positive Definite Matrix, Gauss Elimination Method Gauss-Jordan Elimination Method, Error Analysis for Direct Methods,		
Unit III	**Calculus of finite difference**	6
Finite Difference Operator, Relation between Newton's divided differences in terms of forward, backward and central difference operators, Interpolating Polynomials using Finite Differences		
Unit IV	**Interpolation**	6
Introduction, Methods of Interpolation, Newton Interpolation, Linear Interpolation, Lagrange's Interpolation, Newton's Dividend Difference Interpolation, Truncation Error Bounds, Quadratic Interpolation, Higher Order Interpolation,		
Unit V	**Numerical Differentiation and Integration**	8
Numerical Differentiation, Numerical Differentiation using Linear Interpolation and Quadratic Interpolation Numerical Differentiation For Equally/Unequally Spaced Values of the Arguments, General Newton – Cotes Formula, Trapezoidal Rule, Simpson's Rule, Simpson's three – eighth rule, Weddle's Rule, Error Analysis, Rate of Convergence,		
Text Books	R.K. Jain and S R K Iyengar, Advance Engineering Mathematics, Narosa publication	
Reference Books	1. A Friendly Introduction to Numerical Analysis by Brian Bradie, Sixth Impression, Pearson Prentice Hall. 2. Introductory Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India. 3. Finite Differences and Numerical Analysis by H.C. Saxena, S. Chand Company Ltd. 4. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain Sixth Edition, New Age International Publishers. 5. Applied Numerical Analysis, Seventh Edition, Curtis F. Gerald, Patrick O.Wheateley, Pearson.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3406

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to apply numerical methods to find our solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations.	3	S
CO2	Students will be able to work numerically on the partial differential equations using different methods through the theory of finite differences.	2	S
CO3	Students will be able to work numerically on the ordinary differential equations using different methods through the theory of finite differences	3	S
CO4	Students will be able to solve initial and boundary value problems in differential equations using numerical methods.	2	S
CO5	Students will be able to apply various numerical methods in real life problems.	3	S

CO-PO Mapping for MA3406

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	3	3	2	1	2	2	2	2	2	1	2	2
CO 2	2	3	2	2	2	1	2	2	3	1	3	2	1	1	1
CO 3	3	2	1	2	1	1	3	3	2	2	1	1	2	2	2
CO 4	2	1	2	1	2	2	2	3	2	3	2	2	2	1	1
CO 5	3	3	3	2	3	3	3	2	2	3	2	3	3	3	1
Avg	2.4	2.2	1.8	2.0	2.2	1.8	2.2	2.4	2.2	2.2	2.0	2.0	1.8	1.8	1.4

PH3440	Title: Thermal Physics lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide the knowledge of experiments related to thermal physics	
Expected Outcome	Students will be able to evaluate thermal properties of materials	

At least 5 experiments from the following

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using
   (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and
   to determine Neutral Temperature.

Text Books	
Reference Books	1.B.L. Flint and H.T. Worsnop, Advanced Practical Physics for students, Asia Publishing House 2.Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, Heinemann Educational Publishers 3.I.Prakash& , Ramakrishna, A Text Book of Practical Physics, KitabMahal
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3440

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students should be able to determine the coefficient of thermal conductivity by searle's apparatus	2	S
CO2	Students should be able to determine the coefficient of thermal conductivity by Angstrom's apparatus	2	S
CO3	Students should be able to determine the coefficient of thermal conductivity a bad conductor by lee and Charlton disc method	2	S

CO-PO Mapping for

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	3	1	2	1	1	1	2	2	1	2	1	2	0	1	1
CO 2	2	1	2	1	0	2	1	2	2	1	2	2	0	1	2
CO 3	2	1	1	2	0	2	1	2	1	2	1	2	0	1	1
Avg	2.3	1.0	1.7	1.3	0.3	1.7	1.3	2.0	1.3	1.7	1.3	2.0	0.0	1.0	1.3

MA3440	Title: Numerical Analysis Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To enable students to enhance programming skills	
Expected Outcome	The student will develop programming skills which will enable him to applynumericaltecniques in various problems.	
Unit No.	Unit Title	No. of hours (per Unit)

1. Program to implement Bisection Method
2. Program to implement iterative method
3. Program to implement RegulaFalsi method
4. Program to implement Newton Raphson method
5. Program to implement Newton's Forward method
6. Program to implement Newton's Backward method
7. Program to implement Lagrange's method
8. Program to implement Trapezoidal Rule
9. Program to implement Simpson's 1/3 Rule
10. Program to implement Simpson's 3/8 Rule

Suggested Readings	
Mode of Evaluation	Record Book, Viva- Voce and External Examination.
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for MA3440

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will able to implement various methods for finding the roots of Polynomial equations.	1	S
CO2	Students will able to implement various numerical solutions of Algebraic Equations.	2	S
CO3	Students will able to implement various methods for finite difference and Interpolation.	2	S

CO-PO Mapping for MA3440

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	1	1	2	1	1	2	1	2	2	2	1	1	2	1	2
CO 2	1	2	1	1	1	1	2	3	3	1	2	1	2	1	3
CO 3	1	1	2	2	1	1	1	1	2	1	1	1	1	1	2
Avg	1.0	1.3	1.7	1.3	1.0	1.3	1.3	2.0	2.3	1.3	1.3	1.0	1.7	1.0	2.3

PH3407	Title: Quantum Mechanics	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	PH3306, PH3307	
Objectives	The student will learn about wave function of quantum particle and probabilistic nature of itslocation and through understanding the behavior of quantum particle encountering a i) barrier, ii) potential. The student gets exposed to solving non-relativistic hydrogen atom, for itsspectrum and eigenfunctions and study of influence of electric and magnetic fields on atoms will help in understanding	
Expected Outcome	A student will have the basic knowledge of quantum mechanics calculations and develop an understanding of how to model a given problem such ashydrogen, particle in a box etc. atom etc using wave function, operators and solve them.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Time dependent Schrodinger Equation	6
Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function. Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.		
Unit II	Time Independent Schrodinger Equation	8
Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wave packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle.		
Unit III	General discussion of bound states in an arbitrary potential	9
Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.		
Unit IV	Quantum theory of hydrogen-like atoms	7
Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wave functions from Frobenius method; shapes of the probability densities for ground and first excited states; Orbital angular momentum quantum numbers l and m; s, p, d shells		
Unit V	Atoms in Electric and Magnetic Fields& Many electron atoms	9
Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Normal Zeeman Effect and Stark Effect: Electron Magnetic Moment and Magnetic Energy Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Spin-orbit coupling in atoms-L-S and J-J couplings.		
Text Books	D.J. Griffith, Introduction to Quantum Mechanics, Pearson Education	
Reference Books	P.M. Mathews and K. Venkatesan,A Text book of Quantum Mechanics, McGraw Hill Robert Eisberg and Robert Resnick,Quantum Mechanics, Wiley. Leonard I. Schiff, Quantum Mechanics, Tata McGraw Hill. D.A.B. Miller,Quantum Mechanics for Scientists & Engineers, Cambridge University Press EugenMerzbacher, Quantum Mechanics,John Wiley and Sons, Inc. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer	
Mode of Evaluation	Internal and External Examinations	

Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3407

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Exposition of inadequacies of classical mechanics in explaining microscopic phenomena, quantum theory formulation is introduced through Schrodinger equation to students.	2	Em
CO2	The interpretation of wave function of quantum particle and probabilistic nature of its location and subtler points of quantum phenomena are exposed to the students.	3	S
CO3	Students will understand the behavior of quantum particle encountering a i) barrier, ii) potential,	2	S
CO4	The student gets exposed to solving non-relativistic hydrogen atom, for its spectrum and eigenfunctions.	3	En
CO5	Study of influence of electric and magnetic fields on atoms will help students in understanding Stark effect and Zeeman Effect respectively.	2	None

CO-PO Mapping for PH3407

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	3	1	2	2	1	2	1	2	2	1	2	2
CO 2	2	3	2	1	3	2	1	1	3	1	2	3	2	3	3
CO 3	3	2	2	3	2	1	2	3	2	2	3	2	2	2	2
CO 4	3	3	2	3	1	2	2	3	3	3	2	3	1	3	2
CO 5	3	3	2	2	3	2	1	2	3	1	2	3	2	2	1
Avg	2.8	2.6	2.0	2.4	2.0	1.8	1.6	2.0	2.6	1.6	2.2	2.6	1.6	2.4	2.0

PH3441	Title :Quantum Mechanics Lab	L T P C 0 0 2 1
Version No.	1.1	
Course Prerequisites	Nil	
Objectives	Use C/C++/Scilab for solving the following problems based on Quantum Mechanics	
Expected Outcome	The students will be able to use Scilab with the exposure in computational programming in the computer lab, the student will be in a position to solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three dimensional potentials.	

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$ where $V(r) = -\frac{e^2}{r}$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 $(eVÅ)^{1/2}$, hc = 1973 (eVÅ) and m = 0.511x10^6 eV/c^2.

2. Solve the s-wave radial Schrodinger equation for an atom:

$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential $V(r) = -\frac{e^2}{r}e^{-r/a}$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 $(eVÅ)^{1/2}$, m = 0.511x10^6 eV/c^2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$

For the anharmonic oscillator potential $V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2, k = 100MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3} In these units, ch = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

5. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$ Where μ is the reduced mass of the two-atom system

for the Morse potential $V(r) = D\left(e^{-2\alpha r'} - e^{-\alpha r'}\right), r' = \frac{r - r_0}{r}$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: m = 940x10^6 eV/C^2, D = 0.755501 eV, α = 1.44, r_0 = 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To show the tunneling effect in tunnel diode using I-V characteristics.

8. Quantum efficiency of CCDs	
Text Books	
Reference Books	Schaum's outline of Programming with C++. J.Hubbard,2000,McGraw-Hill Publication Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007,Cambridge University Press. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific &Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernández.2014 Springer. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., CambridgeUniversity Press Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-6133459274
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3441

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be exposed to various modern scientififc experiments that establish quantum mechanics.	1	Em
CO2	The experiments using Sci-lab will enable the student to appreciate nuances involved in theory.	2	S
CO3	In the laboratory course, with the exposure in computational programming in the computer lab, students will be able to diagonalize matrices and calculate eigenvalues and eigenvectors.	3	S

CO-PO Mapping for PH3441

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	3	3	1	2	3	2	2	3	2	3	2	3	2	2	2
CO 2	3	3	2	2	3	2	2	3	1	3	2	3	2	2	2
CO 3	3	3	2	2	2	2	2	3	2	3	2	3	2	2	3
Avg	3.0	3.0	1.7	2.0	2.7	2.0	2.0	3.0	1.7	3.0	2.0	3.0	2.0	2.0	2.3

Specialization in Chemistry

CY3407	Title: Electrochemistry	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites		
Objectives	To provide students with basic electrochemical process under standard &non standard conditions.	
Expected Outcome	To make the quantitative predictions about whether equilibrium favour products or reactant in a redox reaction.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Conductance	8
Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivityand their variation with dilution for weak and strong electrolytes. Molar conductivity atinfinite dilution. Kohlrausch law of independent migration of ions.		
Unit II	Effect of conductance	8
Ionic velocities, mobilities and their determinations, transference numbers and their relationto ionic mobilities, determination of transference numbers using Hittorf and MovingBoundary methods. Applications of conductance measurement: (i) degree of dissociation ofweak electrolytes, (ii) ionic product of water (iii) solubility and solubility product ofsparingly soluble salts, (iv) hydrolysis constants of salts.		
Unit III	Electrochemistry	7
Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ionsbased on half-cell potentials, applications of electrolysis in metallurgy and industry.Chemical cells, reversible and irreversible cells with examples. Electromotive force of a celland its measurement, Nernst equation; Standard electrode (reduction) potential and itsapplication to different kinds of half-cells.		
Unit IV	Determination Of Cell Coefficients	8
(i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH-values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb2O3 electrodes.Concentration cells with and without transference, liquid junction potential; determination ofactivity coefficients and transference numbers. Qualitative discussion of potentiometrictitrations (acid-base, redox, precipitation).		
Unit V	Electrical & Magnetic Properties of Atoms and Molecules	6
Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Dipole moment and molecular polarizabilities and theirmeasurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement,molecular interpretation.		
Text Books	1.Banwell, C. N. &McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. TataMcGraw-Hill: New Delhi	
Reference Books	1.Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3407

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will able to know the electrical conductivity of substance in various aqueous solution	1	S
CO2	Students will able to classify the strong electrolyte, weak electrolyte or non-electrolytes. Determine the effect of molar construction as well as the number of ions in solution on the conductivity..	2	S
CO3	Students will gain knowledge on Quantitative aspects ,different laws, oxidation/reduction potential, application of electrolysis in industries.	2	S
CO4	Students will be able to determine of qualitative & quantitative potentiometric titration, enthalpy and entropy of a cell reaction.	2	S
CO5	Students will learn on basics ideas of electrical and magnetic properties of atom and molecules.	2	S

CO-PO Mapping for CY3407

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1
CO 2	1	1	1	1	1	1	2	1	1	1	1	1	2	1	2
CO 3	1	1	1	1	1	1	1	1	1	1	1	2	2	1	2
CO 4	1	1	1	1	2	2	1	2	1	1	1	1	1	1	1
CO 5	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1
Avg	1.2	1.0	1.0	1.0	1.4	1.6	1.6	1.2	1.0	1.0	1.0	1.2	1.4	1.0	1.4

CY3440	Title: Basics of Hydrocarbon Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites		
Objectives	To Determine melting points of different organic compounds using experimental methods	
Expected Outcome	Imparting skills in handling instruments and chemicals in Suitable manner.	
Exp No	Experiment Title	

1. Checking the calibration of the thermometer

2.Purification of organic compounds by crystallization using the following solvents:
a. Water
b. Alcohol
c. Alcohol-Water

3.Chromatography. Separation of a mixture of two amino acids by ascending and horizontalpaper chromatography

4.Separation of a mixture of two sugars by ascending paper chromatography

5.Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenolby thin layer chromatography (TLC)

6.Potentiometric titration of Mohr's salt with potassium dichromate

7.To determine Electrical Conductivity of aqueous solutions

Text Books	1.Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
Reference Books	1.Pandey, Bajpai, &Giri, "Practical Chemistry", S.Chand Publication.
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3440

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain hands on experience on different kinds of titrations.	1	Emp
CO2	Students will able to learn calibration of instruments and methods involved by performing experiments.	2	S
CO3	Students will be able to know the preparation of standard solutions.	3	Emp

CO-PO Mapping for CY3440

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	2
CO 2	2	1	1	2	2	2	1	1	1	2	2	1	2	1	2
CO 3	1	2	2	2	2	3	1	1	1	1	2	2	2	2	1
Avg	1.3	1.7	1.3	1.7	1.7	2.0	1.3	1.3	1.0	1.3	1.7	1.3	1.7	1.3	1.7

Specialization in Mathematics

MA3407	Title: Abstract Algebra	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To give an introduction to the basic concepts of Abstract Algebra	
Expected Outcome	Students will be able to assess properties implied by the definitions of groups	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Basic Definition and Properties of Groups	8
Definition of a group with examples and simple properties, abelian group, composition table ,order of elements of a group		
Unit II	Subgroup	6
Finite group; Subgroups, General Properties of Subgroups, Theorems and Problems on Subgroups		
Unit III	Cyclic Groups and Permutation Groups	8
Cyclic Group, properties of Cyclic Group and Classification of Subgroups of Cyclic group, Introduction to Permutation Group, Cycle Notation of a Permutation and Properties		
Unit IV	Isomorphism and Theorems on Isomorphism	6
Definition, Cayley's Theorem, Properties of Isomorphism,Automorphisms		
Unit V	Cosets and Lagrange's Theorem	8
Definition, Properties of Cosets, Lagrange's theorem and its consequences, Introduction to Normal Subgroup and Quotient Group (Or Factor Group)		
Text Books	1. Bhamri&Khanna , Abstract algebra, Vikash Publication 2. A.K. Vasishtha& A.R. Vasishtha, Modern Algebra, Krishna Publication, Meerut.	
Reference Books	1. Joseph A. Gallian, Contemporary Abstract Algebra (Fourth Edition), Narosa Publishing House, India, 1999. 2. I.N.Herstein. Topics in Algebra (2nd edition), John Willey and Sons.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3407

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will learn about the group theory and properties of group.	2	Emp
CO2	Students will learn about sub group and theorem based on subgroup. Some special group like zn	3	S
CO3	In this students will learn about cyclic group . student will able to analyze in reference of group .	2	S
CO4	Students will able to understand about group homeomorphism and isomorphism . student is able to understand the statements of theorems based on isomorphism.	3	Enp
CO5	Students understand the concept of Cosets. Students are also able to understand and apply the Lagrange's theorem.	3	None

CO-PO Mapping forPH3340

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	3	1	3	1	2	2	1	2	2	2	1	3	3	1
CO 2	3	2	2	3	1	2	3	2	2	1	2	2	2	3	1
CO 3	2	3	1	3	1	1	2	3	2	2	2	1	3	3	2
CO 4	3	3	1	3	1	2	1	2	2	1	2	2	1	3	1
CO 5	3	3	1	3	1	2	2	2	2	2	2	2	1	3	2
Avg	2.6	2.8	1.2	3.0	1.0	1.8	2.0	2.0	2.0	1.6	2.0	1.6	2.0	3.0	1.4

CY3440	Title: Basics of Hydrocarbon Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites		
Objectives	To Determine melting points of different organic compounds using experimental methods	
Expected Outcome	Imparting skills in handling instruments and chemicals in Suitable manner.	
Exp No	Experiment Title	

1. Checking the calibration of the thermometer

2.Purification of organic compounds by crystallization using the following solvents:
a. Water
b. Alcohol
c. Alcohol-Water

3.Chromatography. Separation of a mixture of two amino acids by ascending and horizontalpaper chromatography

4.Separation of a mixture of two sugars by ascending paper chromatography

5.Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenolby thin layer chromatography (TLC)

6.Potentiometric titration of Mohr's salt with potassium dichromate

7.To determine Electrical Conductivity of aqueous solutions

Text Books	1.Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
Reference Books	1.Pandey, Bajpai, &Giri, “Practical Chemistry”, S.Chand Publication.
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3440

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain hands on experience on different kinds of titrations.	1	Emp
CO2	Students will able to learn calibration of instruments and methods involved by performing experiments.	2	S
CO3	Students will be able to know the preparation of standard solutions.	3	Emp

CO-PO Mapping for CY3440

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	2
CO 2	2	1	1	2	2	2	1	1	1	2	2	1	2	1	2
CO 3	1	2	2	2	2	3	1	1	1	1	2	2	2	2	1
Avg	1.3	1.7	1.3	1.7	1.7	2.0	1.3	1.3	1.0	1.3	1.7	1.3	1.7	1.3	1.7

SEMESTER V

Specialization in Physics

PH3501	Title: Mathematical Physics II	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	MA3107, MA3207	
Objectives	Students will learn the Fourier analysis of periodic functions, special functions and their applications in various physical problems. Additionally students will acquire knowledge of the basic theory of errors, their analysis, methods to solve partial differential equations with examples	
Expected Outcome	The student will be able to solve ODE, PDE's which model physicalphenomena.He / she shall develop an understanding of how to model a given physical phenomena and this will help in understanding the behavior of the model systems	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	FourierSeries	10
Periodic functions. Orthogonality of sine and cosine functions, DirichletConditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourierseries. Expansion of functions with arbitrary period. Expansion of non-periodic functions over aninterval. Even and odd functions and their Fourier expansions. Application. Summing of InfiniteSeries. Term-by-Term differentiation and integration of Fourier Series.Parseval Identity.		
Unit II	Frobenius method and special functions	16
Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of BesselFunctions (Jo(x) and J1(x)) and Orthogonality		
Unit III	Some special integrals	4
Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions.		
Unit IV	Theory of Errors	4
Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Least-squares fit. Error on the slope andintercept of a fittedline.		
Unit V	Partial Differential Equations	10
Solutions to partial differential equations, using separation of variables: Laplace Equation in problems of rectangular, cylindrical, and spherical symmetry. Waveequationforvibrationalmodesofastretchedstring, rectangular and circular membranes. Diffusion equation		
Text Books		
Reference Books	Arfken, Weber, Harris, Mathematical Methods for Physicists, Elsevier. Schaum'sOutlineSeries, Tata McgrawHill M.R. Spiegel, Fourier Analysis, Tata McGraw-Hill. George F. Simmons, Differential Equations, Tata McGraw-Hill. Susan M Lea, Mathematics for physicists, Thomson Brooks/Cole S. Pal and S.C. Bhunia, Engineering Mathematics, Oxford University Press K.F. Riley, M.P. Hobson and S.J. Bence, *Mathematical Methods for Physics and Engineering,* Cambridge University Press S J Farlow, Partial Differential Equations for Scientists and Engineers, Dover publications D A Mcquairre, Mathematical methods for Scientists and Engineers, Viva Books H K Dass and Dr Rama Verma, Mathematical Physics, S Chand	

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3501

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn about Fourier series, periodic functions and their expansion Even and odd function and their Fourier expansion and application of Fourier series .	2	S
CO2	Students will learn about Frobenius method and some special functions (Legendre polynomial, Hermite and Bessel functions) and their properties.	3	S
CO3	Students will learn about some special integrals (Beta and Gamma functions) and should be able to find the relation between them	2	S
CO4	Students will gain knowledge about theory of errors and should be able to find various types of errors.	3	S
CO5	Students will learn about how to find the solution on PDE by variable separable method and should able to apply PDE in various types of applications.	2	S

CO-PO Mapping for PH3501

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	3	1	2	2	3	2	1	1	3	2	2	2
CO 2	3	2	1	2	2	3	2	2	3	2	2	3	2	3	2
CO 3	2	1	3	2	1	2	3	2	2	1	2	2	2	1	3
CO 4	3	2	2	1	2	3	2	3	3	1	1	3	1	2	1
CO 5	2	1	2	2	1	2	3	2	1	2	2	2	1	2	2
Avg	2.4	1.6	2.0	2.0	1.4	2.4	2.4	2.4	2.2	1.4	1.6	2.6	1.6	2.0	2.0

PH3502	Title :Solid State Physics	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	PH3306	
Objectives	The student will learn the basics of crystal structure and physics of lattice dynamics and learn the physics of different types of material like magnetic materials, dielectricmaterials, metals and their properties. He/she will understand the physics of insulators, semiconductor and conductors with specialemphasis on the elementary band theory of semiconductors including the basic theory of superconductors.	
Expected Outcome	The student will know thephysical properties of different materials and relationship between structure and properties giving rise to physics of different types of materials like magnetic materials, dielectricmaterials, metals, semiconductors, superconductors and their properties.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Crystal Structure	10
Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors.Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. ReciprocalLattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law.Atomic and Geometrical Factor.		
Unit II	Elementary Lattice Dynamics	8
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law		
Unit III	Magnetic and Dielectric Properties of Materials	14
Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials.ClassicalLangevin Theory of dia and Paramagnetic Domains. Quantum Mechanical Treatment ofParamagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains.Discussion of B-H Curve. Hysteresis, Energy Loss. **Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. DepolarizationField. Electric Susceptibility. Polarizability. ClausiusMosotti Equation. Classical Theory ofElectric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeirrelations.Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application:Plasma Oscillations, Plasma Frequency, Plasmons.		
Unit IV	Ferroelectric Properties of Materials	6
Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, hysteresis loop.		
Unit V	Elementary band theory and Superconductivity	12
Kronig Penny model. Band Gaps. Conductors, Semiconductorsand insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient. Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field.Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.		
Text Books	Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd.	
Reference Books	Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning Solid State Physics, Rita John, 2014, McGraw Hill Solid-state Physics, H. Ibach and H. Luth, 2009, Springer Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India Solid State Physics, M.A. Wahab, 2011, Narosa Publications	
Mode of Evaluation	Internal and External Evaluations	
Recommendation by Board of Studies on	13-06-2018	

Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3502

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will gain a brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones and diffraction of X-rays by crystalline materials.	2	S
CO2	Students will gain knowledge on lattice vibrations, phonons, Einstein and Debye theory of specific heat of solids.	3	S
CO3	Students will understand about the dielectric materials, different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss.	2	S
CO4	Students will understand about the ferroelectric properties of materials.	2	S
CO5	Students will understand about the band theory of solids and must be able to differentiate insulators, conductors and semiconductors and they will also understand the basic idea about superconductors and their classifications.	3	S

CO-PO Mapping for PH3502

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	3	2	2	3	2	2	2	1	2	2	1	2
CO 2	2	3	2	2	3	2	2	2	3	2	2	3	2	3	2
CO 3	3	2	1	3	2	2	2	3	2	2	1	2	2	2	1
CO 4	2	3	2	2	2	2	2	3	3	2	2	3	2	3	2
CO 5	3	3	2	2	3	2	2	2	3	2	1	3	2	3	2
Avg	2.6	2.6	1.6	2.4	2.4	2.0	2.2	2.4	2.6	2.0	1.4	2.6	2.0	2.4	1.8

PH3503	Title :Advanced Electromagnetic Theory	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	PH3206	
Objectives	Students will learn the role of Maxwell's equations in unifying electricity and magnetism ad implications of Gauge invariance in solving the wave equations and develop the skills to actually solve the wave equation in various media	
Expected Outcome	Student will comprehend the role of Maxwell's equation and derive expression for Energy density, Momentum density, Angular momentum density of the electromagnetic field. They will be able to understand properties of EM waves in different media and the basic physics associated with the polarization of electromagnetic waves	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Maxwell Equations	9
Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. MomentumDensity and Angular Momentum Density.		
Unit II	EM Wave Propagation in Unbounded Media	9
Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagationthrough ionosphere.		
Unit III	EM Wave in Bounded Media	9
Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence)		
Unit IV	Polarization of Electromagnetic Waves	7
EllipticalPolarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature ofDielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation inUniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary& extraordinary refractive indices. Production & detection of Plane, Circularly and EllipticallyPolarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. BabinetCompensator and its Uses. Analysis of Polarized Light. Optical Rotation. Biot's Laws for rotatory Polarization. Fresnel'sTheory of optical rotation. Calculation of angle of rotation. Experimental verification ofFresnel'stheory. Specific rotation. Laurent's half-shade polarimeter.		
Unit V	Wave Guides & Optical Fibres	7
Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on t reflection. Eigen value equations. Phase and group velocity of guided waves. Field energy and Power transmiss Optical Fibres: Numerical Aperture. Step and Graded Indices (Definitions Only).Single and Multiple Mode Fibre		
Text Book	Introduction to Electrodynamics, D.J. Griffiths,Benjamin Cummings	

Reference Books	Elements of Electromagnetics, M.N.O. Sadiku, Oxford University Press. Introduction to Electromagnetic theory, T L Chow, Jones and Bartlett Learning Fundamentals of Electromagnetics, M.A.W. Miah, Tata McGraw Hill Electromagnetic field Theory, R.S. Kshetrimayun, Cengage Learning Engineering Electromagnetic, Willian H. Hayt, McGraw Hill. Electromagnetics, J.A. Edminster, Schaum Series, Tata McGraw Hill. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2015, Cambridge University Press
Mode of Evaluation	Internal and External Evaluations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3503

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to understand Maxwell's equations, role of displacement current, gauge transformations, scalar and vector potentials, Coulomb and Lorentz gauge, boundary conditions at the interface between different media.	2	S
CO2	Students will be able to analyse the phenomena of wave propagation in the unbounded, bounded, vacuum, dielectric, guided and unguided media.	2	S
CO3	Students will be able to understand the laws of reflection and refraction and to calculate the reflection and transmission coefficients at plane interface in bounded media	3	S
CO4	Students will be able to understand the linear, circular and elliptical polarizations of em waves, propagation of em waves in anisotropic media, the concept of optical rotation, theories of optical rotation and their experimental rotation, calculation of angle rotation and specific rotation.	2	S
CO5	Students will be able to understand the features of planar optical wave guide and obtain the Electric field components, Eigen value equations, phase and group velocities in a dielectric wave guide.	2	S

CO-PO Mapping for PH3503

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	1	1	2	1	3	2	2	2	3	2
CO 2	3	3	2	2	2	2	1	1	3	1	2	2	3	2	3
CO 3	3	3	2	2	2	1	1	2	1	2	2	2	2	3	2
CO 4	3	3	2	3	3	2	1	3	2	1	2	2	3	3	2
CO 5	3	3	2	3	3	1	1	1	1	2	2	2	2	2	2
Avg	3.0	3.0	2.0	2.4	2.4	1.4	1.0	1.8	1.6	1.8	2.0	2.0	2.4	2.6	2.2

PH3540	Title :Mathematical Physics II Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Students will learn the basics of the Scilab software and apply it to curve fittings, in solving system of linear equations, generating and plotting special functions such as Legendre polynomial and Bessel functions, solving first and second order ordinary and partial differential equations..	
Expected Outcome	Students will be able to use Scilab for curve fittings, in solving system of linear equations, generating and plotting special functions such as Legendre polynomial and Bessel functions and solving first and second order ordinary and partial differential equations.	
	List of Experiments	

Introduction to Numerical computation software Scilab Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting

Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays andvectorization

User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays

an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program.

Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohm's law to calculate **R**, Hooke's Law to calculate spring constant.
Solution of linear system of equations by gauss elimination method and gauss seidal method. Diagonalization of matrices ,Inverse of a matrix, Eigen values problems.	Solution of mesh equations of of electric circuits (3 meshes) Solution of coupled sprig mass systems (3 masses).
Generation of Special functions using User defined functions in scilab.	Generating and plotting Legendre Polynomials. Generating and plotting Bessel function.

Solution of ODE First order Differential equation Euler, Modified Euler and Runge-Kutta Second order methods Second order differential equation Fixed difference method Partial Differential Equations	First order Differential Equation ● Radioactive decay ● Currents in RC, LC circuits with DC source ● Newton's law of cooling ● Classical equations of motion Second order Differential Equation ● Harmonic Oscillator (frictionless) ● Damped harmonic Oscillator ● Over damped ● Critical damped ● Oscillatory ● Forced Harmonic Oscillator ● Transient ● Steady state solution Apply above to LCR circuits also Solve: $x^2\frac{d^2y}{dx^2} - 4x(1+x)\frac{dy}{dx} + 2(1+x) = x^3$ wit boundary conditions at x=1, $y=\frac{1}{2}e^2$, $\frac{dy}{dx} = -\frac{3}{2}e^2 - 0.5$, in the range 1≤x≤3. Plot y and $\frac{dy}{dx}$ against x in the given range on the same graph. Partial Differential Equation: ● Wave equation ● Heat equation ● Poisson equation ● Laplace equation
Using scicos /xcocs	● Generating square wave, sine wave, saw tooth wave ● Solution to harmonic oscillator ● Study offbeat phenomenon ● Phase space plots

Text Books	
Reference Books	Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson andS. J. Bence, 3rd ed., 2006, Cambridge University Press Complex Variables, A.S. Fokas& M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press First course in complex analysis with applications, D.G. Zill and P.D. Shanahan,1940, Jones & Bartlett Computational Physics, D.Walker, 1st Edn., 2015, Scientific International Pvt. Ltd. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rdEdn., Cambridge University Press Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer Scilab by example: M. Affouf 2012, ISBN: 978-1479203444 Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand& Company Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing www.**scilab**.in/textbook_companion/generate_book/291
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of	13-06-2018

Studies on	
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3540

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students learn the basic of SciLab software and apply it to curve fitting	2	S
CO2	Students will be able to apply Sci lab software in solving linear equation	2	S
CO3	Students will be able to apply Sci lab software in generating and plotting special function and solving first and second order ODE and PDE	3	S

CO-PO Mapping for PH3540

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	1	2	1	2	2	2	1	3	1	2	2
CO 2	2	3	1	2	1	2	1	2	3	2	2	2	1	2	3
CO 3	2	2	2	3	2	3	2	3	2	1	2	2	2	1	1
Avg	2.3	2.3	1.7	2.3	1.3	2.3	1.3	2.3	2.3	1.7	1.7	2.3	1.3	1.7	2.0

PH3541	Title :Solid State Physics Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Students will learn through experiments the physics of different types of material like magnetic materials, dielectricmaterials, metals and their properties.	
Expected Outcome	Students will be able tocarry out experiments based on the theory that they have learned to measure themagnetic susceptibility, dielectric constant, trace hysteresis loop. They will also employ to four probe methods to measure electrical conductivity and the hall set up to determinethe hall coefficient of a semiconductor.	

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) technique.
6. To determine the refractive index of a dielectric using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150^{o}C) by four-probe method and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Text Books	
Reference Books	B.L. Flint and H.T. Worsnop, Advanced Practical Physics for students, Asia Publishing House. Michael Nelson and Jon M Ogborn, Advanced level physics practicals, Heinemann Educational publishers A Text Book of Practical Physics, I.Prakash& Ramakrishna, KitabMahal Elements of Solid State Physics, J.P. Srivastava, Prentice-Hall of India
Mode of Evaluation	Internal and External Evaluations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3541

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to carry out experiments based on theory that have learnt to measure the magnetic stability.	2	S
CO2	Students will be able to carry out experiments on dielectric constant and trace hysteresis loop.	2	S
CO3	Students will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.	2	S

CO-PO Mapping for

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	2	2	1	2	2	2	1	2	1	2	1	2	2
CO 2	2	2	1	2	1	2	1	1	1	2	2	3	1	2	1
CO 3	1	1	2	1	2	1	2	1	2	1	2	2	2	1	1
Avg	1.7	1.3	1.7	1.7	1.3	1.7	1.7	1.3	1.3	1.7	1.7	2.3	1.3	1.7	1.3

PH3542	Title :Electromagnetic Theory Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide the knowledge of experiments related to electromagnetism including polarization related experiments	
Expected Outcome	Students will be able to evaluate and understand properties of materials and interaction of polarized light with materials using electromagnetism based experiments	

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine Boltzmann constant using V-I characteristics of PN junction diode.

Text Books	
Reference Books	Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
Mode of Evaluation	Internal and External Evaluations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3542

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be gaining knowledge on electromagnetism including polarization related experiments.	2	S
CO2	Students will be able to understand and evaluate properties of materials	2	S
CO3	Students will gain knowledge on interaction of polarized light with materials using electromagnetism based experiments.	2	S

CO-PO Mapping for PH3542

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	1	2	2	1	2	1	2	1	2	1	2	1	2	2
CO 2	2	1	1	2	1	2	1	1	1	2	2	2	1	2	2
CO 3	1	1	2	1	2	1	2	1	2	1	2	1	2	1	1
Avg	2.0	1.0	1.7	1.7	1.3	1.7	1.3	1.3	1.3	1.7	1.7	1.7	1.3	1.7	1.7

PH3511	Title: Digital Systems and Applications	L T P C 3 0 2 4
Version No.	1.0	
Course Prerequisites	EC3101	
Objectives	Students will learn the basics of IC and digital circuits, and difference between analog and digital circuits, various logic GATES and their realization using diodes and transmitters. They will also learn fundamental of Boolean algebra and their role in constructing digital circuits, learn about combinatorial and sequential systems by building block circuits to construct multivibrators and counters, understand basics of microprocessor and assembly language programming with examples..	
Expected Outcome	Students will acquire skills to understanding the functioning and operation of CRO to measure physical quantities in electrical and electronic circuits. He/she will be able to handle both active and passive components and also to learn about integrated circuits. They will be able to simplify and construction digital circuits by employing Boolean algebra	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to CRO Integrated Circuits (Qualitative treatment only)	8
Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Active and Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.		
Unit II	Digital Circuits	7
Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.		
Unit III	Boolean Algebra	7
De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.		
Unit IV	Intel 8085 Microprocessor Architecture	7
Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing and Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI.		
Unit V	Sequential Circuits &Timers & Shift Registers	7
SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.IC 555: block diagram and applications: Astablemultivibrator and Monostable multivibrator.Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).		
Text Books		

Reference Books	1. Digital Principles and Applications, A.P.Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw 2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd. 3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. 4. Digital Electronics G K Kharate ,2010, Oxford University Press 5. Logic circuit design, Shimon P. Vingron, 2012, Springer. 6. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. 7. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill 8. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
Mode of Evaluation	Internal and External Evaluations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3511

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Student is expected to be conversant with the Basic working of an oscilloscope including its different components and to employ the same to study different wave forms and to measure voltage, current, frequency and phase.	2	S
CO2	Students will secure first-hand idea of different components including both active and passive components to gain a insight into circuits using discrete components and also to learn about integrated circuits.	3	S
CO3	Students will learn about analog systems and digital systems and their differences, fundamental logic gates, combinational as well as sequential and number systems. Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.	2	S
CO4	Students will be able to understand the sequential systems by choosing FlipFlop as a building bock- construct multivibrators, counters to provide a basic idea about memory including RAM,ROM and also about memory organization.	2	S
CO5	Students will be able to understando the microprocessor and assembly language programming with special reference to IntelμP8085.	3	S

\

CO-PO Mapping for PH3511

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	2	2	2	2	1	1	2	2	0	2	2
CO 2	2	3	2	2	2	1	1	2	2	1	1	3	0	1	3
CO 3	2	2	2	3	3	2	1	2	3	1	2	2	0	2	2
CO 4	3	2	2	3	3	2	2	2	1	1	1	3	0	2	3
CO 5	3	2	3	1	2	2	3	2	2	1	2	2	0	2	2
Avg	2.6	2.2	2.2	2.2	2.4	1.8	1.8	2.0	1.8	1.0	1.6	2.4	0.0	1.8	2.4

PH3512	Title: Applications of Quantum Mechanics	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	PH3407	
Objectives	Students will learn the formalism in Quantum mechanics and applications such as Time independent and time dependent perturbation theory, scattering, WKB approximation and Tunneling	
Expected Outcome	A student will have the knowledge of scope of quantum mechanics calculations and how to apply it to some important quantum systems	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Formalism in Quantum Mechanics	10
Hilbert space and observables, Eigenfunctions of a Hermitian operator, generalized statistical interpretation, the uncertainty principle, Dirac Notation. Identical systems-Two particle systems, indistinguishability in quantum mechanics, bosons and fermions		
Unit II	Time Independent perturbation theory	9
Non degenerate perturbation theory. degenerate perturbation theory. The fine structure if Hydrogen. The Zeeman Effect. Hyperfine splitting		
Unit III	Variational principle and WKB approximation	7
Ground state of Helium, Hydrogen molecule ion. Classical region. Tunneling		
Unit IV	Time dependent perturbation theory	7
Two level systems, emission and absorption of radius, Spontaneous emission, Adiabatic Approximation: Adiabatic theorem and Berry phase		
Unit V	Scattering and other special cases	8
Introduction, Partial wave analysis, phase shifts, The Born Approximation, The EPR paradox, Bell'stheorem. Schrodinger's Cat		
Text Books	D.J. Griffith, Introduction to Quantum Mechanics, Pearson Education	
Reference Books	P.M. Mathews and K. Venkatesan,A Text book of Quantum Mechanics, McGraw Hill Robert Eisberg and Robert Resnick, Quantum Mechanics, Wiley. Leonard I. Schiff, Quantum Mechanics, Tata McGraw Hill. A.Ghatak and S. Lokanathan, Quantum mechanics: Theory and Applications, Kluwer Academic Press. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley Eugen Merzbacher, Quantum Mechanics, John Wiley and Sons, Inc. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3512

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn the formalism in Quantum mechanics and applications	2	S
CO2	Students will learn time independent perturbation theory	3	S
CO3	Students will acquire skills to understand WKB approximation and Tunneling	2	S
CO4	Students will be able to handle time dependent perturbation theory	1	S
CO5	Student will have the knowledge of scope of quantum mechanics calculations and how to apply it to some important quantum systems like scattering.	2	S

CO-PO Mapping for PH3512

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	1	1	2	1	2	3	1	2	2	1	2	3	0	2	2
CO 2	2	2	3	1	1	2	2	2	1	2	2	3	0	1	2
CO 3	1	1	1	2	2	1	2	3	2	1	2	1	0	2	3
CO 4	2	2	2	1	2	2	1	2	2	1	2	1	0	1	1
CO 5	1	2	2	2	1	1	1	2	3	2	3	1	0	3	2
Avg	1.4	1.6	2.0	1.4	1.6	1.8	1.4	2.2	2.0	1.4	2.2	1.8	0.0	1.8	2.0

PH3513	Title: Astronomy and Astrophysics	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Students will learn the basic parameters for describing the properties of starsand making experimental measurements, their interpretation and role in understandingof astrophysical phenomenon. Study of solar and stellar spectra and acquire basic knowledge of Milky Way and Galaxies, their properties and structure.	
Expected Outcome	Students will develop skills for understanding basics of large scale structures and expanding universeand be aware of astronomical instruments to perform observations related tothe positional astronomy measurement.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Astronomical Scales, Basic concepts of positional astronomy:	16
Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness,RadiantFluxand Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii,Masses of Stars, Stellar Temperature. **Basic concepts of positional astronomy:** Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale, Distance Modulus; Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Stellar Spectral Classification, Hertzsprung-Russell Diagram.		
Unit II	Astronomical techniques and Physcical Principles	6
Astronomical techniques: Basic Optical Definitions for Astronomy (MagnificationLightGathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), OpticalTelescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and their Use with Telescopes (Types of Detectors, detection Limits with Telescopes). **Physical principles:** Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein),Systems in Thermodynamic Equilibrium.		
Unit III	The sun, Stellar spectra and classification Structure	8
The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere.Corona, SolarActivity, Basics of Solar Magneto-hydrodynamics. Helioseismology). **The solar family** (SolarSystem: Facts and Figures, Origin of the Solar System: TheNebular Model, Tidal Forces andPlanetary Rings, Extra-Solar Planets. **Stellar spectra and classification Structure (**Atomic Spectra Revisited, Stellar Spectra,SpectralTypes and Their Temperature Dependence, Black Body Approximation, H R Diagram,Luminosity Classification)		
Unit IV	The milky way	10
The milky way : Basic Structure and Properties of the Milky Way, Nature of Rotation oftheMilky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of theGalaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the MilkyWay, Properties of and around the Galactic Nucleus.		
Unit V	Galaxies, Large scale structure & expanding universe:	12
Galaxies: Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (TheIntrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and LenticularGalaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy,Spiral Arms. **Large scale structure & expanding universe:** Cosmic Distance Ladder (An Example fromTerrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (Distance-Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).		
Text Books		

Reference Books	Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing. The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books. Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002. BaidyanathBasu, 'An introduction to Astro physics', Second printing, Prentice -Hall of India Private limited, New Delhi,2001. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3513

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn the basic parameters for describing the properties of stars and making experimental measurements	2	S
CO2	Students will be able to explain about interpretation and role in understanding of astrophysical phenomenon.	1	S
CO3	Students will be capable to explain solar and stellar spectra	1	S
CO4	Student will acquire basic knowledge of Milky Way and Galaxies, their properties and structure.	2	S
CO5	Students will develop skills for understanding basics of large scale structures and expanding universe and be aware of astronomical instruments to perform observations related to the positional astronomy measurement.	3	S

CO-PO Mapping for PH3513

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	2	1	2	3	1	2	2	1	2	3	0	2	2
CO 2	2	2	1	2	1	2	1	2	1	1	2	2	0	1	2
CO 3	1	1	1	2	2	1	2	3	2	2	2	1	0	2	3
CO 4	2	2	2	1	2	2	1	2	2	1	2	1	0	1	1
CO 5	1	1	2	2	1	2	1	2	1	2	2	1	0	2	3
Avg	1.6	1.4	1.6	1.6	1.6	2.0	1.2	2.2	1.6	1.4	2.0	1.6	0.0	1.6	2.2

PH3514	Title: Nuclear and Particle Physics	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	PH3306	
Objectives	To understand Skills to describe and explain the properties of nuclei and derive them from various models of nuclear structure and particle Physics	
Expected Outcome	Students will gain knowledge to understand, explain and derive the various theoretical formulation of nuclear physics and will develop basic understanding of nuclear reactions and decays with help of theoretical formulae.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	General Properties of Nuclei and Nuclear Models:	16
General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. **Nuclear Models**: Liquid drop model approach, semi empirical mass formula and significance ofits various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermions gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.		
Unit II	Radioactivity decay and Nuclear Reactions:	12
Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α-emission,Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rayemission& kinematics, internal conversion. **Nuclear Reactions:** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonancereaction, Coulomb scattering (Rutherford scattering).		
Unit III	Interaction of Nuclear Radiation with matter:	5
Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.		
Unit IV	Detector for Nuclear Radiations:	5
Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube(PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility),neutron detector.		
Unit V	Particle Accelerators and Particle physics:	10
Particle Accelerators: Accelerator facility available in India: Van-de Graaff Generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons. **Particle physics:** Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quarkmodel,color quantum number and gluons.		
Text Books		
Reference Books	Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008). Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998). Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004). Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press Introduction to Elementary Particles, D. Griffith, John Wiley & Sons Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOPInstituteof Physics Publishing, 2004). Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000). Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007). Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991)	

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3514

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will gain knowledge on general properties of nuclei and various nuclar models	2	S
CO2	Students will learn about the basic concept of radioactive deacy and nuclear reactions	2	S
CO3	Students will be able to understand the theory behind interaction of nuclear radiation with matter	3	S
CO4	Students will learn about the various types of detector including their construction and working involves in nuclear radiation	2	S
CO5	This unit provide a brief knowledge to the students about various types of accelerator and particle physics	1	S

CO-PO Mapping for PH3514

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	2	1	1	2	3	2	2	2	1	0	1	1
CO 2	1	2	2	2	1	3	2	2	1	1	1	2	0	1	2
CO 3	1	3	2	3	1	1	1	1	1	2	2	2	0	3	1
CO 4	2	2	2	2	2	2	2	1	3	1	2	2	0	2	2
CO 5	2	3	2	3	1	2	3	2	2	3	2	2	0	1	2
Avg	1.4	2.4	2.0	2.4	1.2	1.8	2.0	1.8	1.8	1.8	1.8	1.8	0.0	1.6	1.6

Specialization in Chemistry

CY3501	Title: Organometallic Chemistry	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites		
Objectives	The main goal of the work developed in this area is the production of high quality research in the area of organ metallic chemistry	
Expected Outcome	To give a systematic introductory treatment of organometallic Compounds emphasizing synthesis properties,structure& reactivity.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Classification of Organometallic Compounds	8
Definition and classification of Organometallic compounds on the basis of bond type.Concept of hapticity of organic ligands.Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substitutedmetal carbonyls of 3d series.		
Unit II	Methods of Preparation	8
General methods of preparation (direct combination, reductivecarbonylation, thermal and photochemical decomposition) of mono and binuclear carbonylsof 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Niusing VBT. Acceptorbehavior of CO (MO diagram of CO to be discussed).		
Unit III	Metal Alkyls	8
Important structural features of methyl lithium (tetramer) and trialkylaluminium (dimer), concept of multicentre bonding in these compounds. Role oftriethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, MannichCondensation). Structure and aromaticity. Comparison of aromaticity and reactivity with thatof benzene.		
Unit IV	Reaction Kinetics and Mechanism	8
Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes,Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planarcomplexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand fieldeffects and reaction rates, Mechanism of substitution in octahedral complexes.		
Unit V	Catalysis by Organometallic Compounds	7
Study of the following industrial processes and their mechanism: 1. Alkene hydrogenation (Wilkinsons Catalyst) 2. Hydroformylation (Co salts) 3. Wacker Process 4. Synthetic gasoline (Fischer Tropsch reaction) 5. Synthesis gas by metal carbonyl complexes		
Text Books	1. Cotton, F.A. G.; Wilkinson &Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.*	
Reference Books	2. Wiley India,Huheey, J. E.; Keiter, E.A. &Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.,* Harper Collins 1993,	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3506

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to know the structures, properties, application and the chemical reactivity.	1	S
CO2	Students will gain knowledge on the preparation of carbonyls of 3rd series and study the structure.	2	S
CO3	Students will gain knowledge on interaction of metal and ligands.	1	S
CO4	Students will gain knowledge on reaction kinetics and mechanism of complexes	2	S
CO5	Students will gain knowledge on organometallic compounds are used as catalyst in various chemical reactions.	1	None

CO-PO Mapping for CY3506

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	2	1	1	1	1	1	1	2	1	1	2	1
CO 2	2	2	1	1	2	1	2	2	1	1	1	1	1	2	1
CO 3	1	1	2	2	1	1	1	1	1	1	1	2	2	1	1
CO 4	2	1	1	1	2	1	1	1	2	1	1	1	1	1	2
CO 5	1	1	2	1	1	2	2	1	1	1	1	1	1	1	2
Avg	1.2	1.0	1.0	1.4	1.2	1.2	1.4	1.2	1.2	1.0	1.2	1.2	1.0	1.2	1.4

CY3502	**Title: Heterocyclic Chemistry**	**L T P C** **3 1 0 4**
Version No.	**1.0**	
Course Prerequisites		
Objectives	The major objective of present study is the rationalization of the reactivity of heteroaromatic compound.	
Expected Outcome	Heterocyclic compound continue to attract considerableInterest as they contribute to the development of society frombiological industrial and Understanding view points.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Classification &Structure of heterocyclic compounds**	8
Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered ringscontaining one heteroatom;		
Unit II	**Synthesis & mechanism of reactions**	8
Synthesis, reactions and mechanism of substitution reactions of:Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis)		
Unit III	**Reaction Mechanism**	8
Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole,Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline andisoquinoline, . Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, ..Derivatives of furan: Furfural and furoic acid		
Unit IV	**Alkaloids**	6
Natural occurrence, General structural features, Isolation and their physiological actionHoffmann's exhaustive methylation, Emde's modification, Structure elucidation andsynthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine,Morphine, Cocaine, and Reserpine.		
Unit V	**Terpenes**	6
Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral,Neral and α-terpineol.		
Text Books	1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (IndiaPvt. Ltd. (Pearson Education).	
Reference Books	2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd(Pearson Education). 3. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry ofNatural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, JohnWelly& Sons (1976).	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3502

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand the classification and structure of heterocyclic compounds.	1	S
CO2	Students will be able to understand the synthesis and reaction mechanism of Furan, Pyrrole.	2	S
CO3	Students will be able to understand the reaction mechanism and can elucidate the structure of heterocyclic compounds.	2	S
CO4	Students will be able to understand the nature, occurrence, general features and their properties of Alkaloids.	1	S
CO5	Students will be able to understand the nature, occurrence, general features and can able to elucidate the structure and synthesis of Terpenes.	2	S

CO-PO Mapping for CY3502

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	1
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.0	1.2	1.2	1.8	1.2	1.6	1.2	1.0	1.4

CY3503	Title: Chemical Kinetics	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites		
Objectives	To study about the concept of reaction rates and experimental methods to determine the rate law.	
Expected Outcome	It will enhance knowledge about surface chemistry and phase eqilliberia	
Unit No.	Unit Title	No of hours (per Unit)
Unit I	Chemical Kinetics	8
Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.		
Unit II	Variation Of Reaction Rates	8
Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.		
Unit III	Concept ofCatalysis & Surface chemistry	8
Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis. Physical adsorption, chemisorptions, adsorption isotherms. Nature of adsorbed state.		
Unit IV	Phase Equilibria	9
Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid,liquid-vapour and solid-vapourequilibrium, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.		
Unit V	Binary solutions	8
Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation.Nernst distribution law: its derivation and applications.		
Text Books	1. Mortimer, R. G. *Physical Chemistry 3rd Ed.*, Elsevier: NOIDA, UP (2009).	
Reference Books	1. Levine, I. N. *Physical Chemistry 6th Ed.*, Tata McGraw-Hill (2011). 2. Metz, C. R. *Physical Chemistry 2nd Ed.*, Tata McGraw-Hill (2009).	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3503

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand the basics in Chemical kinetics.	1	S
CO2	Students will be learning about variation of reaction rates.	2	S
CO3	Students will be learning about concepts of catalysis and surface chemistry	1	S
CO4	Students will be learning about concepts of Phase Equilibrium.	1	S
CO5	Students will be learning about Binary Solutions and its applications.	1	S

CO-PO Mapping for CY3503

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	1
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	2
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.0	1.2	1.2	1.8	1.2	1.6	1.2	1.0	1.4

CY3547	**Title: Inorganic Chemistry Lab**	**L T P C** **0 0 2 1**
Version No.	**1.0**	
Course Prerequisites		
Objectives	To prepare the inorganic and organic compounds by various methods.	
Expected Outcome	Student will learn synthesis of different compounds	
Exp No	**Exp Title**	
I	1. Tests for following functional groups **Qualitative Analysis:** Identification of cations and simple anions in a mixture of salts containing not more than six ions (Three cations and three anions) interfering anions using semimicro scheme of analysis. If combination of cations or anions is given in the mixture, insoluble should be avoided. Spot tests should be carried out for final identifications wherever feasible. **Cation :Pb2+, Bi3+ Cu2+, Cd2+, As3+, Sb3+, Sn2+ or Sn4+, Fe2+ OR Fe3+, Al3+, Cr3+,Co2+, Ni2+, Zn2+, Mn2+, Ba2+, Sr2+, Ca2+, Mg2+, NH4+, K+** **Anion : $CO3^{2-}$, $SO3^{2-}$,CO2, , S2-, $NO-^{2}$, CH3COO-, $NO-^{3}$, Cl^{-}, Br-, I-, $SO4^{2}$-, $PO4,^{3}$-, BO**	
II	Qualitative analysis of following types of unknown organic compounds 1. Carbohydrates 2. Primary, secondary and tertiary amines	
III	Qualitative analysis of following types of unknown organic compounds 3. Nitro compounds 4. Amides	
Text Books	**Reference text:** 1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.	
Reference Books		
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3547

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand the basics in Chemical kinetics.	2	S
CO2	Students will be learning about variation of reaction rates.	1	S
CO3	Students will be learning about concepts of catalysis and surface chemistry	2	S
CO4	Students will be learning about concepts of Phase Equilibrium.	1	S
CO5	Students will be learning about Binary Solutions and its applications.	1	S

CO-PO Mapping for CY3547

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	2
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	2
CO 5	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
Avg	1.0	1.0	1.5	1.4	1.2	1.0	1.0	1.1	1.2	2.0	1.2	1.6	1.2	1.0	2.0

CY3541	**Title: Heterocyclic Chemistry Lab**	**L T P C** 0 0 2 1
Version No	**1.0**	
Course Prerequisites		
Objectives	To prepare the inorganic and organic compounds by various methods.	
Expected Outcome	Student will learn synthesis of different compounds	
Exp No	Exp Title	
I	Estimation ofPhenol and aniline by bromination with potassium bromate-potassium bromide method.	
II	Saponification value of an oil/fat	
II	Diels-Alder reaction between anthracene and maleic anhydride	
III	Reduction: nitrobenzene to azobenzene (TLC of the mixture), m-dinitrobenzene to m-nitroaniline.	
IV	Photochemical reduction of benzophenone to benzopinacol.	
V	Complexometric Titrations: (i) Complexometric estimation of (i) Mg2+ (ii) Zn2+ using EDTA (ii) Estimation of total hardnesss of water samples.	
VI	Argentometry Estimation of Cl^- (i) By Mohr's method, (ii) By Vohlard's method,	
VII	Paper Chromatographic separation of Ni (II) and Co(II); Cu(II) and Cd (II)C	
Text Books	**Reference text:** 1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.	
Reference Books		
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3548

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to prepare various organic and inorganic compounds by different methods.	2	Emp
CO2	Students will be able to perform Complex metric titrations.	2	S
CO3	Students will be able to estimate Phenol, Aniline and find out saponification value of oil and f	3	S

CO-PO Mapping for CY3548

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	1	1	1	1	2	2	2	1	1	2	1	1
CO 2	1	1	2	1	2	1	2	1	1	2	1	1	1	2	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
Avg	1.0	1.0	2.0	1.3	1.3	1.0	1.3	1.3	1.3	2.0	1.3	1.3	1.3	1.3	1.7

Programme Electives

CY3511	**Title: Green Chemistry**	**L T P C** **4 0 0 4**
Version No.	**1.0**	
Course Prerequisites		
Objectives	The aim of green chemistry is to reduce the chemical related impacton human health virtually eliminated contamination of environment.	
Expected Outcome	To develop the designing of biodegradable products	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Introduction to Green Chemistry**	5
What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry.Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.		
Unit II	**Principles of Green Chemistry and Designing a Chemical synthesis**	8
Twelve principles of Green Chemistry with their explanations and examples; Designing aGreen Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy);prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separationagents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy		
Unit III	**Green Synthesis/ Reactions**	10
. Green Synthesis of the following compounds: adipic acid, catechol, BHT, methylmethacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide,acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen,paracetamol, furfural. Ultrasound assisted reactions: Esterification, saponification, substitution reactions,Alkylations, oxidation, reduction, coupling reaction, Cannizaro reaction, Strecker synthesis		
Unit IV	**Reformatsky reaction**	8
Selective methylation of active methylene group using dimethylcarbonate: Solid-statepolymerization of amorphous polymers using diphenylcarbonate; Use of "Clayan", anonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role ofTellurium in organic syntheses; Biocatalysis in organic syntheses		
Unit V	**Future Trends in Green Chemistry**	8
Oxidation reagents and catalysts; Biomimetric, multifunctional reagents; Combinatorial greenchemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistryin sustainable development		
Text Books	V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry,Anamalaya Publishers (2005)	
Reference Books	P.T. Anastas& J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3511

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be learning about basics in Green Chemistry.	1	S
CO2	Students will gain knowledge on principles of green chemistry.	2	S
CO3	Students will gain knowledge on green synthesis and their reactions.	2	S
CO4	Students will be gaining knowledge on Reformatsky reactions	1	S
CO5	Students will be learning about future trends in green chemistry	2	S

CO-PO Mapping for CY3511

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.0	1.2	1.2	1.8	1.2	1.6	1.2	1.0	1.6

CY3513	Title: Industrial Chemicals and Environment	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites		
Objectives	To study the organic & inorganic chemicals used in industry &their effects on environment	
Expected Outcome	The aim of the study to removes the hazardous material from environment.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Industrial Gases and Inorganic Chemicals	7

Industrial Gases: Large scale production uses storage and hazards in handling of the following gases: Oxygen, Nitrogen, Argon, Neon, Helium, Hydrogen, Acetylene, Carbon monoxide, Chlorine, Fluorine, Sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: Hydrochloric acid, Nitric acid, sulphuric acid, caustic soda, common salt,borax, bleaching powder, sodium thiosulphate,hydrogen peroxide, potash alum,chromealum, potassium dichromate and potassium permanganate.

Unit II	Industrial Metallurgy	8

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductortechnology

Unit III	Environment and its segments	8

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions inatmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemicalsmog: its constituents and photochemistry. Environmental effects of ozone, Major sources ofairpollution.Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases.Effects of air pollution on living organisms and vegetation. Greenhouse effect and Globalwarming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removalofsulphur from coal. Control of particulates.

Water Pollution: Techniques for measuring water pollution, Impacts of waterpollution on hydrological and ecosystems.Water purification methods. Effluent treatment plants (primary, secondary and tertiarytreatment). Industrial effluents from the following industries and their treatment:electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc.Sludgedisposal.Industrial waste management, incineration of waste. Water treatment and purification(reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water,industrial water and domestic water.

Unit IV	Energy & Environment	7

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy,Hydrogen, geothermal, Tidal and Hydel, etc.Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Unit V	Biocatalysis	6

Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry

Text Books	1. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. NewDelhi.
Reference Books	1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK. 2. J. A. Kent: Riegel’s *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
Mode of Evaluation	
Recommendation by Board of Studies on	13-06-2018
Date of approval by the	13-07-2018

Course Outcome for CY3513

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain knowledge on fundamentals of organic & inorganic chemicals	1	S
CO2	Students will gain knowledge on basic concepts of chemicals used in industry	1	S
CO3	Students will gain knowledge to removes the hazardous material.	2	S
CO4	Students will gain knowledge on industry chemicals.	2	S
CO5	Students will gain knowledge on soil chemistry.	1	S

CO-PO Mapping for CY3513

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	2	1	1	2
CO 3	1	1	2	2	1	1	2	1	1	2	2	2	1	1	1
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.2	1.2	1.2	1.8	1.2	1.8	1.2	1.0	1.4

Specialization in Mathematics

MA3501	Title: Linear Algebra	L T P C 4 2 0 5
Version No.	1.0	
Course Prerequisites	MA3407	
Objectives	To give an introduction to the basic concepts of Linear Algebra	
Expected Outcome	Students will be able to assess properties implied by the definitions of vector space .	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Linear Space	8
Vector spaces and their elementary properties, Subspaces, linear sum, direct sum and releted theorem		
Unit II	Bases and dimensions	8
Linear dependence and independence, and related theorems Basis and dimension.		
Unit III	Linear transformation	8
Linear transformations and their algebra, Range and null space, Rank and nullity, Matrix representation of linear transformations, Change of basis		
Unit IV	Types of Matrices	8
Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal and unitary matrices, Triangular and diagonal matrices, Rank of a matrix, Elementary transformations, Echelon and normal forms, Inverse of a matrix by elementary transformations		
Unit V	Eigen value and Eigen vector	8
Characteristic equation, Eigen values and eigen vectors of a matrix, Cayley- Hamilton's theorem and its use in finding inverse of a matrix, Application of matrices to solve a system of linear (both homogeneous and non-homogeneous) equations, Consistency and general solution, Diagonalization of square matrices with distinct eigen values,		
Text Books	1. Linear Algebra , Author U.S Rana , Anand Publication, Merrut. 2. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971	
Reference Books	1. S Lang, Introduction to Linear Algebra (2nd edition), Springer,2005 2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007 3. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3501

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to critically analyze and construct mathematical arguments that relate to the study of introductory linear algebra.	2	S
CO2	Students will be able to utilise visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R2 and R3, as well as conceptually extend these results to higher dimensions.	3	S
CO3	Students will be able to understand the concepts linear transformation between vector spaces, discuss its matrix relative to given bases. Describe geometrically significant linear transformations of the plane to itself.	3	S
CO4	Students will be able to use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, orthogonality and diagonalization.	2	S
CO5	Students able to understood and use characteristic polynomials to compute eigen values and eigen vectors and use eigenvectors to represent a linear transformation with respect to a particularly nice basis.	3	S

CO-PO Mapping forMA3501

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	3	3	2	1	2	3	2	3	3	1	2	2
CO 2	2	3	3	2	1	3	2	3	2	1	2	2	3	3	2
CO 3	3	2	1	2	3	1	2	3	2	2	1	3	2	1	2
CO 4	1	2	2	1	2	2	3	3	2	3	2	3	2	3	2
CO 5	3	2	3	2	3	3	1	2	3	3	2	1	2	3	2
Avg	2.2	2.2	2.4	2.0	2.4	2.2	1.8	2.6	2.4	2.2	2.0	2.4	2.0	2.4	2.0

MA3502	Title: Linear Programming Problems	L T P C 4 2 0 5
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To solve simple industrial problems by linear programming problem.	
Expected Outcome	Students will able to understand liner industrial problems.	
Unit No	Unit Title	No. of hours (per Unit
Unit I	Introduction of LPP	9
Formulation of LPP, General LPP, Canonical and Standard forms, convex sets theory, Graphical Method , Basics of solutions.		
Unit II	Simplex methods	8
Theory of Simplex method, Big M Method and Two phase simplex method, Degeneracy in LPP.		
Unit III	Revised Simplex Method	8
Revised simplex method standard form 1 and 2.		
Unit IV	Duality	6
Principal of Duality in LPP, Dual simplex method.		
Unit V	Transportation and assignment	9
Mathematical formulation and optimal solution, solutions of Assignment problems.		
Text Books	1. S Kalavati ,operation research 4th Edition , Vikas publishing house private limited.	
Reference Books	1-Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows* (2nd edition), John Wiley and Sons, India, 2004. 2. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research-Concepts and Cases* (9th Edition), Tata McGraw Hill, 2010. 3. Hamdy A. Taha, *Operations Research, An Introduction* (9th edition), Prentice-Hall, 2010.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3502

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to analyze and solve linear programming models of real life situations.	3	S
CO2	Students will be able to provide graphical solution of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.	3	S
CO3	Students will be able to solve linear programming problems using simplex method.	2	S
CO4	Students will be able to construct the dual model of a given LP model and explain economic meanings of dual variables. They will be also able to analyze sensitivity of the optimum solution according to changes in the model parameters and model structure and use software for the solution of LP models.	3	Enp
CO5	**Students will learn techniques to solve transportation and assignment problems.**	2	None

CO-PO Mapping forMA3502

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	3	3	3	1	2	2	2	3	3	2	2	3
CO 2	2	3	3	2	1	2	2	2	2	1	2	2	3	3	2
CO 3	3	2	1	2	2	1	2	2	3	2	1	3	2	1	1
CO 4	3	2	2	1	2	2	3	2	1	3	2	3	2	3	2
CO 5	1	2	3	2	3	3	1	3	1	3	2	1	3	3	2
Avg	2.2	2.2	2.4	2.0	2.2	2.2	1.8	2.2	1.8	2.2	2.0	2.4	2.4	2.4	2.0

MA3503	Title: Integral Transforms	L T P C 4 2 0 4
Version No.	1.0	
Course Prerequisites	MA3207,MA3107	
Objectives	To introduce the theoretical concepts of transform..	
Expected Outcome	Students will be familiar with various methods that lead to solving Engineering problems.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Concept of Integral transform	8
The concept of transforms and kernel, Laplace transform and related theorems.		
Unit II	Inverse Laplace transform	8
Inverse Laplace transform, Convolution theorem.		
Unit III	Application of Laplace transform	8
Applications of Laplace transform to solve ordinary differential equations.		
Unit IV	Fourier transform	8
Fourier transforms (finite and infinite), Fourier integral,		
Unit V	Application of fourier transform	8
Applications of Fourier transform to boundary value problems, Fourier series.		
Text Books	Integral Transforms by Vasishtha A.K (Author), Gupta R K (Author).	
Reference Books	An introduction to integral transforms paperback – 2016by BaidyanathPatra (Author).	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3503

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain knowledge on the application of laplace transform and also learn to solve PDE and DE by laplace transform.	3	Em
CO2	Students will be able to learn about the application of Fourier transform and also about Fourier series.	3	S
CO3	Students will be able to understand the concept of transforms, kernel, laplace transform and their theorems.	2	S
CO4	Students will gain knowledge of Fourier Transform for finite and infinte,Fourier integral, Fourier series of periodic function .	3	En
CO5	Students will learn about Inverse Laplace transform and differentiation on inverse Laplace, theorems on inverse Laplace.	2	None

CO-PO Mapping for MA3503

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	2	1	3	2	1	2	2	3	3	2
CO 2	3	3	1	3	3	2	2	3	1	2	2	3	3	3	2
CO 3	2	3	1	3	1	2	1	3	1	2	1	2	2	3	2
CO 4	3	3	2	3	1	2	2	3	2	3	2	3	3	3	2
CO 5	2	2	1	2	2	1	1	2	1	2	1	2	2	2	1
Avg	2.6	2.8	1.4	2.6	1.8	1.8	1.4	2.8	1.4	2.0	1.6	2.4	2.6	2.8	1.8

MA3511	Title: Discrete Mathematics	LT P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To give an introduction to the basic concepts of Boolean Algebra and graphs.	
Expected Outcome	Students will be able to understand Boolean expression and graphs.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Propositional logics	10
Propositional Logic - Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction,. Method of Proof - Mathematical induction, proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof by using truth table, proof by counterexample.		
Unit II	Relation	8
Relation - Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation.		
Unit III	Lattices	7
Lattices: Logic: propositional and predicate. lattices as partially ordered sets and as algebraic systems.		
Unit IV	Boolean algebra	8
Introduction to Boolean algebra :Boolean functions and expressions. Application of Boolean algebra to switching circuits(using AND, OR and NOT gates)		
Unit V	Graph	7
Graphs and Planar Graphs: Graph, Multigraph, Weighted Graphs, Directed graphs. Paths and circuits.		
Text Books	1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 199 2. Mk gupta	
Reference Books	1. S. Wiitala, Discrete Mathematics: A Unified Approach, McGraw-Hill Book Co. 2. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3511

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand propositions and then would be able to find out the validity of the argument.	2	Emp
CO2	Students will be able to understand the concepts of set along with proofs to prove equality in sets. Various operations on sets, Principle of inclusion and exclusion, and various properties of Relation.	3	S
CO3	Students will gain complete knowledge of lattices as partially ordered sets and as algebraic systems.	2	S
CO4	Students will be able to understand Boolean functions and expressions. Application of Boolean algebra	2	Enp
CO5	Students will be able to understand Graphs and Planar Graphs: Graph, Multigraph, Weighted Graphs, Directed graphs. Paths and circuits.	3	None

CO-PO Mapping for MA3511

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO 1	3	2	2	2	3	2	1	3	2	1	2	2	3	3	3
CO 2	3	2	2	3	3	2	2	3	1	2	2	3	3	3	2
CO 3	3	2	1	3	2	2	1	3	1	2	1	2	2	3	2
CO 4	3	2	2	3	1	2	2	3	2	3	2	3	3	3	3
CO 5	3	2	1	2	2	1	1	2	1	2	1	2	2	2	2
Avg	3.0	2.0	1.6	2.6	2.2	1.8	1.4	2.8	1.4	2.0	1.6	2.4	2.6	2.8	2.4

MA3512	Title: Differential Geometry	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	MA3206	
Objectives	The course will serve as an introduction to Theory of curve and theory of surfaces.	
Expected Outcome	Students will have general background in differential geometry .	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Local theory of curves	8
Space curves, Examples, Plane curves, tangent and normal and binormal, Osculating plane, normal plane and rectifying plane,contact between curve and surfaces, tangent surfaces, involutes and evolutes of curves		
Unit II	Intrinsic equations	8
Intrinsic equations, fundamental existence theorem for space curves,Local theory of surfaces- Parametric patches on surface curve of a surface		
Unit III	Local theory of surfaces	8
Direction coefficients, families of curves, intrinsic properties, geodesics, canonical geodesic equations, normal properties of geodesics.		
Unit IV	Curvature	8
geodesics curvature, geodesics polars, Gauss-Bonnet theorem, Gaussian curvature, normalcurvature,Meusneir's theorem, mean curvature, Gaussian curvature, umbilic points, lines ofcurvature, Rodrigue's formula, Euler's theorem.		
Unit V	The fundamental equation of surface theory	8
The fundamental equation of surface theory – The equation of Gauss, the equation of Weingarten, the Mainardi-Codazzi equation.		
Text Books	1. Differential Geometry by D. Somasundaram. 2. Tensors and Differential Geometry by H.D Pandey, Publisher- PragatiPrakashan	
Reference Books	1. Differential Geometry by Weatherburn	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3512

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to critically analyze and construct mathematical arguments that relate to the study of introductory linear algebra.	2	S
CO2	Students will be able to utilise visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R2 and R3, as well as conceptually extend these results to higher dimensions.	3	S
CO3	Students will be able to understand the concepts linear transformation between vector spaces, discuss its matrix relative to given bases. Describe geometrically significant linear transformations of the plane to itself.	3	S
CO4	Students will be able to use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, orthogonality and diagonalization.	2	s
CO5	Students able to understood and use characteristic polynomials to compute eigen values and eigen vectors and use eigenvectors to represent a linear transformation with respect to a particularly nice basis.	3	None

CO-PO Mapping for MA3512

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	1	3	1	3	1	3	1	2	1	2	2	3
CO 2	2	3	1	3	1	1	3	3	2	2	1	2	2	3	1
CO 3	3	3	2	2	2	2	2	2	3	2	3	2	3	2	2
CO 4	2	2	3	3	3	1	2	3	2	2	2	2	1	3	3
CO 5	1	3	2	3	2	1	3	2	3	2	3	2	3	2	2
Avg	2.2	2.6	2.2	2.4	2.2	1.2	2.6	2.2	2.6	1.8	2.2	1.8	2.2	2.4	2.2

MA3513	Title: Mechanics I	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	MA3206	
Objectives	This course will provide a theoretical basis for doing experiments in related areas.	
Expected Outcome	Familiarize with subject matter, which has been the single centre, to which weredrawn mathematicians, physicists, astronomers, and engineers together..	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Centers of gravity	8
Centres of gravity of plane area including a uniform thin straight rod, triangle, circular arc,semicircular area and quadrant of a circle, Centre of gravity of a plane area bounded by acurve, Centre of gravity of a volume of revolution;		
Unit II	Virtual Work	10
Equilibrium of a particle, Necessary conditions ofequilibrium, Moment of a force about a point and about a line, Couples,Moment of a couple, Work and potential energy, Principle ofvirtual work for a system of coplanar forces acting on a particle or at different points of arigid body, Forces which can be omitted in forming the equations of virtual work.		
Unit III	Catenary	6
Flexible strings, Common catenary,Intrinsic and Cartesian equations of the common catenary, Approximations of the catenary.		
	Kinematics	8
Kinematics and kinetics of the motion, Expressions for velocity and acceleration in Cartesian,polar and intrinsic coordinates; Motion in a vertical circle, projectiles in a vertical plane andcycloidal motion..		
Unit V	Rectilinear Motion	8
Simple harmonic motion (SHM) and its geometrical representation, SHM under elasticforces, Motion under inverse square law, Motion in resisting media, Concept of terminalvelocity.		
Text Books	1. S. L. Loney (2006). *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies*. Read Books. 2. P. L. Srivastava (1964). *Elementary Dynamics*. Ram NarinLal, Beni Prasad Publishers Allahabad. 3. J. L. Synge & B. A. Griffith (1949). *Principles of Mechanics*. McGraw-Hill.	
Reference Books	1. A. S. Ramsey (2009). *Dynamics*. Cambridge University Press. 2. R. S. Verma (1962). *A Text Book of Statics*. Pothishala Pvt. Ltd.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3513

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand the role of vectors and coordinate systems . Explain the conservation of energy, momentum, angular momentum and apply them to basic problems	2	S
CO2	Students will be able to Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.	2	S
CO3	Students will be able to explain gravitational field and apply to describe the motion of planets and satellite in circular orbit.	3	S
CO4	Students will be able to explain the phenomena of simple harmonic motion and damped and driven harmonic motion.	2	S
CO5	Students will be able to describe how fictitious forces arise in a non-inertial frame, special relativistic effects and their effects on the mass and energy	3	S

CO-PO Mapping for MA3513

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	2	2	3	2	2	2	1	2	2	2	3	2
CO 2	2	2	3	2	2	1	2	3	2	2	2	3	2	3	3
CO 3	1	2	2	2	2	3	2	3	2	3	2	1	2	2	2
CO 4	3	2	2	2	2	2	2	2	2	2	2	3	2	3	0
CO 5	2	2	2	2	2	3	2	3	2	3	2	2	2	3	2
Avg	1.8	2.0	2.0	2.0	2.0	2.4	2.0	2.6	2.0	2.2	2.0	2.2	2.0	2.8	1.8

\

MA3514	Title: Scientific computing using Matlab	L T P C 4 0 0 5
Version No.	1.0	
Course Prerequisites	MA3407	
Objectives	To give an introduction to the basic concepts of Linear Algebra	
Expected Outcome	Students will be able to assess properties implied by the definitions of vector space .	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Matlab& Error estimation	8
Introduction to Matlab, floating of Function & symbolic computation in Matlab, Function definition, plottingpoint representation of a number ,errors arithmetic .		
Unit II	Linear & Non Linear Algebraic equations	8
Iteration method & Bisection Method for solving non linear equation, Order of conversance of an iteration method , Regula-Falsi Method , Newton Raphson Method , Gauss elimination Method & Gauss Jacobi method for linear equation , Matlab Code.		
Unit III	Matrix	8
Power Method for solving Eigen Value of Matrix , Gershgorin Circle Theorem for Estimating Eigen Value of Matrix, Matlab Code for power method,		
Unit IV	Initial value problems (IVP)	8
Interpolation , Interpolation polynomial using Newton's Forward deferential Formula & Newton's Backward deferential Formula , Striling& langrage's Interpolation polynomial formula. Cubic Spline.		
Unit V	Boundary value problems (BVP)	8
Curve Fitting, Quadratic Polynomial fitting & Code for Lagrange's interpolating, Interpolation polynomial using octane , Matlab Code for Newton Divided's deference & least square Approximation & Numerical Differentiation.		
Text Books	1Matlaband its application in engineering.(RajkumarBansal,Pearson) IInd edition 2. Understanding Matlab: A Textbook for Beginners (English, Paperback, S.N. Alam, S.S. Alam)	
Reference Books	1. Matlab (English, Undefined, Gilat Amos) forth edition 2. Matlab and simulink for engineer (Agam Kumar Negi,Oxford)	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3514

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be understand the need for simulation/implementation for the verification of mathematical functions.	2	S
CO2	Students will understand the main features of the MATLAB/SCILAB program development environment to enable their usage in the higher learning.	3	S
CO3	Students will be able to implement simple mathematical functions/equations in numerical computing environment such as MATLAB/SCILAB.	3	S
CO4	Students will be able to interpret and visualize simple mathematical functions and operations thereon using plots/display.	2	S
CO5	Students will be able to analyze the program for correctness and determine/estimate/predict the output and verify it under simulation environment using MATLAB/SCILAB tools.	3	S

CO-PO Mapping for MA3514

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	1	3	1	3	1	3	1	2	1	2	2	3
CO 2	2	3	1	3	1	1	3	3	2	2	1	2	2	3	1
CO 3	3	3	2	2	2	2	2	2	3	2	3	2	3	2	2
CO 4	2	2	3	3	3	1	2	3	2	2	2	2	1	3	3
CO 5	1	3	2	3	2	1	3	2	3	2	3	2	3	2	2
Avg	2.2	2.6	2.2	2.4	2.2	1.2	2.6	2.2	2.6	1.8	2.2	1.8	2.2	2.4	2.2

SEMESTER VI

Specialization in Physics

PH3601	Title: Mathematical Physics III	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites	MA3107, MA3207	
Objectives	The students will learn about the complex numbers and their properties, functions of complex numbersand their properties such as analyticity, poles and residues. The students are expected tolearn the residue theorem and its applications in evaluating definite integrals, Fourier transform, the inverse Fourier transform, their properties andtheir applications in physical problems. They are also expected to learn the Laplacetransform, the inverse Laplace transforms, their properties and their applications insolving physical problems.	
Expected Outcome	The students will be able to use their knowledge of various mathematical tools like complex analysis, integral transform and will be able to solve a given ODE, PDE.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	**Complex Analysis I**:	10
Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions.		
Unit II	**Complex Analysis II**:	10
Singular functions: poles and branch points, order of singularity, branch cuts. Integration of afunction of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply andmultiply connected region. Laurent and Taylor 's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.		
Unit III	**Integral Transforms**:	8
Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Property of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.		
Unit IV	**Laplace Transforms I**	8
Laplace Transform (LT) of Elementary functions. Properties ofLTs:Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, transform.		
Unit V	**Laplace Transforms II**	8
Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2^{nd} order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace		
Text Books		
Reference Books	K.F. Riley, M.P. Hobson and S.J. Bence, *Mathematical Methods for Physics and Engineering*, Cambridge University Press Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications Complex Variables, A.S.Fokas&M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press Complex Variables, A.K. Kapoor, 2014, Cambridge Univ. Press Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones& Bartlett	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3601

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students should be able to gain knowlege on complex numbers and learn about the function of complex variable.	2	S
CO2	Students will learn about the properties (such as analyticity, poles and residues) of complex variable.	2	S
CO3	Students will be able to evaluate fourier transform, the inverse fourier transform, their properties and their applications in physical problems.	1	S
CO4	Students will learn about the laplace transform and its properties and they will be able to apply these properties in physical problem.	2	S
CO5	Students will learn about the inverse laplace transform, its properties and application in solving physical problem.	2	S

CO-PO Mapping for PH3601

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	2	1	2	1	3	2	1	2	1	2	2
CO 2	2	1	2	2	1	1	2	3	2	1	3	2	2	3	3
CO 3	1	1	1	1	3	2	1	2	3	2	1	2	3	1	2
CO 4	2	2	2	2	3	1	2	3	2	1	2	3	2	1	2
CO 5	1	3	2	1	2	2	2	2	2	2	1	2	1	1	2
Avg	1.4	1.8	1.6	1.4	2.2	1.4	1.8	2.2	2.4	1.6	1.6	2.2	1.8	1.6	2.2

PH3602	Title: Statistical Mechanics	L T P C 3 1 0 4
Version No.	1.0	
Course Prerequisites	PH3406	
Objectives	Students will learn the basic concepts and definition of physical quantities in classical statistics and classical distribution law and learn the application of classical statistics to theory of radiation.	
Expected Outcome	Students will be able to comprehend the failure of classical statistics and need for quantum statistics to derive and understand (1). Bose Einstein statistics and its applications to radiation. (2) Fermi-Dirac statistic and its applications to quantum systems	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Classical Statistics	12
Macrostate and Microstate, Phase Space, Elementary Concept of Ensemble, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof)– Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.		
Unit II	Classical Theory of Radiation	8
Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Radiation Pressure. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe.		
Unit III	Quantum Theory of Radiation	5
Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law		
Unit IV	Bose-Einstein Statistics	9
B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.		
Unit V	Fermi-Dirac Statistics	9
Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar MassLimit.		
Reference Books	Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill S Lokanathan and R S Gambhir, Statistical and Thermal Physics, Prentice Hall Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	

Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3602

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn about the basic concepts and definition of physical quantities in classical statistics and classical distribution law.	2	S
CO2	Students will learn about the application of classical statistics to theory of radiation.	2	S
CO3	Students will be able to comprehend the failure of classical statistics and need for quantum statistics.	1	S
CO4	Students will learn about the application of quantum statistics to derive and understand Bose Einstein statistics and its applications to radiation.	2	S
CO5	Students will learn about the application of quantum statistics to derive and understand Fermi Diarc statistics and its applications to Quantum system.	2	S

CO-PO Mapping for PH3602

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	2	1	1	1	1	1	2	2	1	2	3
CO 2	3	2	2	2	2	1	1	2	2	2	2	2	1	1	2
CO 3	2	2	2	2	2	1	1	3	2	2	2	2	2	2	2
CO 4	3	2	2	3	3	1	1	1	1	1	2	2	1	3	1
CO 5	3	2	2	3	3	1	1	2	1	1	2	2	1	3	1
Avg	2.6	2.0	2.0	2.4	2.4	1.0	1.0	1.8	1.4	1.4	2.0	2.0	1.2	2.2	1.8

PH3640	Title :Mathematical Physics III Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The student will be able to develop skills that will help in understanding the behavior of the modeled systems	
Expected Outcome	The students should apply their C++/Scilabprogramminglanguage to solve the following problems: (i) Solution first- and second- order ordinary differential equations with appropriate boundary conditions, (ii) Evaluation of the Gaussian integrals, (iii) Evaluation of a converging infinite series up to a desired accuracy, (iv) Evaluation of the Fourier coefficients of a given periodic function, (v) Plotting the Legendre polynomials and the Bessel functions of different orders and interpretations of the results, (vi) Least square fit of a given data to a graph,	
	List of Experiments	

Scilab/C++ based simulations experiments based on Mathematical Physics problems like

1. *Solve differential equations:*

$\frac{dy}{dx} = e^{-x}$ *with y=0 for x=0.*

$\frac{dy}{dx} + e^{-x}y = x^2$

$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$

$\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$

2. *Dirac Delta Function*

Evaluate:

$\frac{1}{\sqrt{2\pi a^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}$ *(x+3) dx for* $\sigma = 1., 0.1, 0.01$ *and show it tends to 5.*

3. *Fourier series:*

Program to sum $\sum_{n=1}^{\infty} 0.2^n$,
Evaluate the Fourier coefficients of a given periodic function (square wave).

4. *Frobeniusmethod and Special functions:*

- $\int_{-1}^{1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}$

Plot $P_n(X), j_v(X)$*.Show recursion relation.*

5. *Calculation of error of each observations recorded in experiments done in previous semesters (choose any two).*
6. *Calculate of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.*
7. *Evaluation of trigonometric functions e.g.sin* $\sin\theta$ *,*
Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ *numerically and check with computer integration.*
8. *Compute the* n^{th} *roots of unity for n = 2, 3 and 4.*
9. *Find the square roots of -5 + 12j.*
10. *Integral transform FFT of*
11. *Solve Kirchhoff's current law for any node of any arbitrary circuit using Laplace's transform.*
12. *Solve Kirchhoff's voltage law for any loop of an arbitrary circuit using Laplace's transform.*
13. *Perform circuit analysis of a general LCR circuit using Laplace's transform.*

Text Books	
Reference Books	Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V.Fernández. 2014 Springer ISBN: 978-3319067896 A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn.,Cambridge University Press Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444 Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand& Company Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing https://web.stanford.edu/~boyd/ee102/**laplace**_ckts.pdf ocw.nthu.edu.tw/ocw/upload/12/244/12handout.pdf

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3640

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to apply their C++/Scilab programming language to solve the first- and second- order ordinary differential equations with appropriate boundary conditions,	2	S
CO2	Students will be able to apply their C++/Scilab programming language to solve the Fourier coefficients of a given periodic function and plot a square wave and other functions	3	S
CO3	Students will be able to apply their C++/Scilab programming language to plot Least square fit of a given data to a graph, the Legendre polynomials and the Bessel functions of different orders	3	S

CO-PO Mapping for PH3640

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	3	2	2	3	2	3	2	3	1	2	3
CO 2	3	3	2	3	3	2	2	2	3	2	2	3	2	2	2
CO 3	3	3	3	3	3	2	2	2	2	3	2	2	1	2	2
Avg	3.0	3.0	2.3	2.7	3.0	2.0	2.0	2.3	2.3	2.7	2.0	2.7	1.3	2.0	2.3

PH3641	Title :Statistical Mechanics Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The students will learn to use computer simulations to study: (a) Planck's Black Body radiation Law and compare with the Wien's Law and Raleigh -Jean's Law in appropriate temperature region. (b) Specific Heat of Solids by comparing, Dulong-Petit, Einstein's & Debye's Lawsand study their temperature dependence	
Expected Outcome	Students shall acquire the skills of solving the thermal physics problems using computational techniques with inferring the right theoretical explanations of results. Use C/C++/Scilab/other numerical simulations for solving the problems based on Statistical Mechanics	
	List of Experiments	

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
b) Study of transient behavior of the system (approach to equilibrium)c) Relationship of large N and the arrow of timed) Computation of the velocity distribution of particles for the system & comparison with Maxwell velocity distribution) Computation and study of mean molecular speed and its dependence on particle mass
f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed
2. Computation of the partition function Z(β) for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics:
a) Study of how Z(β), average energy <E>, energy fluctuation ΔE, specific heat at constant volume Cv, depend upon the temperature, total number of particles N and the spectrum of single particle states.
b) Ratios of occupation numbers of various states for the systems considered above
c) Computation of physical quantities at large and small temperature T and comparison ofvarious statistics at large and small temperature T.
3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at highand low temperature
4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debyedistribution function for high temperature and low temperature and compare them for thesetwo cases.
5. Plot the following functions with energy at different temperatures
a) Maxwell-Boltzmann distribution ; b) Fermi-Dirac distribution ; c) Bose-Einstein distribution

Text Books	
Reference Books	Elementary Numerical Analysis, K.E.Atkinson, 3 r d E d n . 2 0 0 7, Wiley India Edition Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, OxfordUniversity Press. Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987 Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer Statistical and Thermal Physics with computer applications, Harvey Gould and JanTobochnik, Princeton University Press, 2010. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: ScientificandEngineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernández. 2014SpringerISBN: 978-3319067896 Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444 Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub., ISBN: 978-6133459274
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018

Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3641

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to design and perform some experiments to determine Boltzmann' Constant	2	S
CO2	Use Computer simulations to study: i. Planck's Black Body radiation Law and compare with the Wien's Law and Raleigh - Jean's Law in appropriate temperature region. ii. Specific Heat of Solids by comparing, Dulong-Petit, Einstein's and Debye's Laws and study their temperature dependence	3	S
CO3	Compare the following distributions as a function of temperature for various energies and the parameters of the distribution functions: i. Maxwell-Boltzmann distribution ii. Bose-Einstein distribution iii. Fermi-Dirac distribution	3	S

CO-PO Mapping for PH3641

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO 10	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	2	2	3	2	2	2	2	2	3	2	3	2	1	2	2
CO 2	3	3	3	2	3	2	2	2	3	1	3	2	1	2	2
CO 3	3	3	3	2	3	2	2	2	3	2	3	2	1	2	3
Avg	2.7	2.7	3.0	2.0	2.7	2.0	2.0	2.0	3.0	1.7	3.0	2.0	1.0	2.0	2.3

PH3551	Title:Digital Systems and Applications Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Students will learn the basics of the functioning and operation of CRO to measure physical quantities in electrical and electronic circuits. Learn the basics of IC and digital circuits, and difference between analog and digital circuits. Various logic GATES and their realization using diodes and transmitters.	
Expected Outcome	Students will be able to use CRO to measure voltage, current, frequency and phase and construct both combinational circuits and sequential circuits by employing NAND as building blocks and demonstrate Adders, Subtractors,Shift Registers, and multivibrators using 555 ICs. He/She is also expected to use µP 8085 to demonstrate the same simple programme using assembly language and execute theprogramme using a µP kit.	

At least 06 experiments each from section A and Section B

Section-A: Digitalcircuits Hardware design/Verilog Design

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To design a combinational logic system for a specified Truth Table.

(b) To convert Boolean expression into logic circuit & design it using logic gate ICs.

(c) To minimize a given logic circuit.

3. Half Adder, Full Adder and 4-bit binary Adder.
4. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
5. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
6. To build JK Master-slave flip-flop using Flip-Flop ICs
7. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
8. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
9. To design an astable multivibrator of given specifications using 555 Timer.
10. To design a monostable multivibrator of given specifications using 555 Timer.

Section-B: Programs using 8085 Microprocessor:

1. Addition and subtraction of numbers using direct addressing mode
2. Addition and subtraction of numbers using indirect addressing mode
3. Multiplication by repeated addition.
4. Division by repeated subtraction.
5. Handling of 16-bit Numbers.
6. Use of CALL and RETURN Instruction.
7. Block data handling.

8. Other programs (e.g. Parity Check, using interrupts, etc.).	
Text Books	
Reference Books	• Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill. • Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill. • Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall. Microprocessor 8085:Architecture, Programming and interfacing, A.Wadhwa, 2010, PHI Learning.
Mode of Evaluation	Internal and External Evaluations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3551

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn the basics of IC and digital circuits and difference between analog and digital circuits.	2	S
CO2	Students will acquire skills to understand the functioning and operation of CRO to measure physical quantities in electrical and electronic circuits.	3	S
CO3	Students will be able to handle both active and passive components and also learn about integrated circuits.	2	S

CO-PO Mapping for PH3551

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	2	2	2	2	3	2	3	2	3	0	2	2
CO 2	2	3	2	1	2	3	2	2	2	3	2	3	0	2	2
CO 3	3	3	2	2	2	2	2	3	2	3	2	3	0	2	3
Avg	2.3	3.0	2.0	1.7	2.0	2.3	2.0	2.7	2.0	3.0	2.0	3.0	0.0	2.0	2.3

PH3611	Title: Analog Systems and Its Applications	L T P C 3 0 2 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The students will learn the basics of the N- and P- type semiconductors, mobility, drift velocity, fabrication of P-N junctions; forward and reverse biased junctions. Application of PN junction for different type of rectifiers and voltage regulators, NPN and PNP transistors and basic configurations namely common base, common emitter and common collector, and also about current and voltage gain. Biasing and equivalent circuits, coupled amplifiers and feedback in amplifiers and oscillators, Operational amplifiers and knowledge about different configurations namely inverting and non-inverting and applications of operational amplifiers in D to A and A to D conversions	
Expected Outcome	The students will be able to understand and work with semiconductor diodes and use them as rectifiers, work with junction transistor, different types of amplifiers including operational amplifier.(Op-Amp) and their applications, sinusoidal oscillators of various types and A/D conversion.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Semiconductor Diodes	6
P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Mechanism in Forward and Reverse Biased Diode.		
Unit II	Two-terminal Devices and their Applications	6
(1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell, Qualitative idea of Schottky diode and Tunnel diode.		
Unit III	Bipolar Junction Transistors	7
n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q- point. Physical Mechanism of Current Flow.		
Unit IV	Amplifiers, Coupled Amplifier , Feedback in Amplifiers	8
Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Classification of Class A, B & C Amplifiers **Two stage** RC-coupled amplifier and its frequency response. Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.		
Unit V	Applications of Op-Amps , Conversion	9
(1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Comparator and Zero crossing detector (8) Wein bridge oscillator. D/A Resistive networks (Weighted and R-2R Ladder). Accuracy and Resolution , Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency.Hartley&Colpittsoscillators, Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.		
Text Books		
Reference Books	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall. Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6th Edn.,2009, PHI Learning Electronic Devices & circuits, S.Salivahanan&N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India	

	Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning Microelectronic Devices & Circuits, David A.Bell, 5th Edn.,2015, Oxford University Press
Mode of Evaluation	Internal and External Evaluations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3611

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to understand the basic concept of N- and P- type semiconductors, mobility, drift velocity, fabrication of P-N junctions; forward and reverse biased junctions	2	S
CO2	Students will learn and understand the application of PN junction for different type of rectifiers and voltage regulators.	2	S
CO3	Students will be able to understand the basic concept of NPN and PNP transistors and basic configurations namely common base, common emitter and common collector, and also about current and voltage gain.	3	S
CO4	Students will be able to understand various biasing and equivalent circuits, coupled amplifiers, feedback in amplifiers and oscillators.	2	S
CO5	Students will learn about operational amplifiers and gain knowledge on different configurations namely inverting and non-inverting and applications of operational amplifiers in D to A and A to D conversions.	2	S

CO-PO Mapping for PH3611

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	1	2	2	2	1	1	1	1	1	1	3	0	1	1
CO 2	3	2	2	2	2	1	1	1	1	1	2	2	0	2	2
CO 3	3	3	2	2	2	1	1	2	3	1	1	3	0	3	3
CO 4	2	3	3	2	3	1	1	3	2	1	2	2	0	2	2
CO 5	2	3	1	2	2	1	1	2	1	1	1	2	0	2	1
Avg	3.0	3.0	3.0	2.4	2.4	1.0	1.0	1.8	1.6	1.0	1.4	2.4	0.0	2.0	1.8

PH3612	Title: Classical Dynamics	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	PH3106	
Objectives	Students will learn Newtonian, the Lagrangian and the Hamiltonian formulations of classical mechanics and their applications in appropriate physical problems including the special theory of relativity and basics of fluid dynamics, streamline and turbulent flow, Reynolds's number, coefficient of viscosity and Poiseuille's equation.	
Expected Outcome	Students will be able to write Lagrangian for mechanical system in terms of generalised coordinates, derive Euler-Lagrange equation of motion and solve them for simplemechanical systems, write Hamiltonian for mechanical systems and derive and solve Hamilton'sequation of motion for simple mechanical systems.Additionally they will be able to develop the basic concepts of special theory of relativity and its applications to dynamical systems of particles and understand the basic concepts of fluid dynamics and its applications toSimpleproblems in liquid flow.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Classical Mechanics of Point Particles	8
Review of Newtonian Mechanics; Application tothe motion of a charge particle in external electric and magnetic fields-motion in uniform electric field, magnetic field- gyroradius and gyrofrequency, motion in crossed electric and magneticfields. Generalized coordinates and velocities, Hamilton's principle, Lagrangian and the Euler-Lagrange equations, one-dimensional examples of the Euler-Lagrange equations- onedimensional.		
Unit II	Simple Harmonic Oscillations and Applications:	8
Simple Harmonic Oscillations and falling body in uniform gravity; applications tosimple systems such as coupled oscillators Canonical momenta & Hamiltonian. Hamilton'sequations of motion.Applications: Hamiltonian for a harmonic oscillator, solution of Hamilton's equation for SimpleHarmonic Oscillations; particle in a central force field-conservation of angular momentum andenergy.		
Unit III	Small Amplitude Oscillations:	8
: Minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations example of N identical masses connected in a linear fashion to (N -1) - identical springs.		
Unit IV	Special Theory of Relativity:	18
Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Spacetimediagrams. Time -dilation, length contraction and twin paradox. Four-vectors: space-like,time-like and light-like. Four-velocity and acceleration. Metric and alternating tensors. Fourmomentumand energy-momentum relation. Doppler effect from a four-vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application totwo-body decay of an unstable particle.		
Unit V	Fluid Dynamics:	8
Density and pressure P in a fluid, an element of fluid and its velocity, continuity equation and mass conservation, stream-lined motion, laminar flow, Poiseuille'sequation for flow of a liquid through a pipe, Navier-Stokes equation, qualitative description ofturbulence, Reynolds number.		
Text Books		

Reference Books	Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley. The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003, Elsevier. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press
Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for PH3612

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn Newtonian, the Lagrangian and the Hamiltonian	2	S
CO2	Students will learn the formulations of classical mechanics and their applications	3	S
CO3	Student will understand the points of stable equilibrium, expansion of the potential energy in appropriate physical	2	S
CO4	Student are able to solve the Four-velocity and acceleration. Metric and alternating tensors	2	S
CO5	Students will understand about fluid dynamics, streamline and turbulent flow, Reynolds's number,coefficient of viscosity and Poiseuille's equation.	3	S

CO-PO Mapping for PH3612

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	1	2	2	1	1	1	1	1	2	2	1	2	3	2
CO 2	1	2	2	1	2	2	2	1	2	1	2	1	3	1	2
CO 3	2	1	3	2	1	1	1	2	1	2	2	2	1	3	1
CO 4	2	2	1	3	3	2	2	1	2	1	2	2	2	2	2
CO 5	1	1	3	3	2	1	1	1	1	1	2	1	2	3	3
Avg	1.6	1.4	2.2	2.2	1.8	1.4	1.4	1.2	1.4	1.4	2	1.4	2	2.4	2

PH3613	Title: Physics of Earth	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The student will learn the origin of Universe, Earth, its satellite Moon and in general evolution of present day Universe. Additionally they will learn modern global seismology as a probe of the Earth's internal structure, the origin of magnetic field, Geodynamics of earthquakes and the description of seismic sources Climate and various roles played by water cycle, carbon cycle, nitrogen cycles to maintain steady state of earth shall be explored.	
Expected Outcome	The student will have the knowledge of the place of Earth in this Universe and its formation, structure and its evolution shall enable the student to appreciate the reasons for keeping Earth 'SAFE'	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	The Earth and the Universe and Structure	16

Earth and Universe

(a) Origin of universe, creation of elements and earth. A Holistic understanding of our dynamicplanet through Astronomy, Geology, Meteorology and Oceanography. Introduction tovarious branches of Earth Sciences.

(b) General characteristics and origin of the Universe. The Milky Way galaxy, solar system,Earth's orbit and spin, the Moon's orbit and spin. The terrestrial and Jovian planets.Meteorites& Asteroids. Earth in the Solar system, origin, size, shape, mass, density,rotational and revolution parameters and its age.

(c) Energy and particle fluxes incident on the Earth.

(d) The Cosmic Microwave Background.

Structure

(a) The Solid Earth: Mass, dimensions, shape and topography, internal structure, magnetic field,geothermal energy. How do we learn about Earth's interior?

(b) The Hydrosphere: The oceans, their extent, depth, volume, chemical composition. Riversystems.

(c) The Atmosphere: variation of temperature, density and composition with altitude, clouds.

(d) The Cryo-sphere: Polar caps and ice sheets. Mountain glaciers.

(e) The Biosphere: Plants and animals. Chemical composition, mass. Marine and landorganisms.

Unit II	Dynamical Processes I	8

(a) The Solid Earth: Origin of the magnetic field. Source of geothermal energy. Convection inEarth's core and production of its magnetic field. Mechanical layering of the Earth.

Introduction to geophysical methods of earth investigations. Concept of plate tectonics; seafloorspreadingand continental drift. Geodynamic elements of Earth: Mid Oceanic Ridges,trenches, transform faults and island arcs. Origin of oceans, continents, mountains and rift valleys. Earthquake and earthquake belts. Volcanoes: types products and distribution.

(b) The Hydrosphere: Ocean circulations. Oceanic current system and effect of coriolisforces.Concepts of eustasy, tend – air-sea interaction; wave erosion and beach processes. Tides.Tsunamis.

Unit III	Dynamical Processes II:Atmosphere and Biosphere	4

The Atmosphere: Atmospheric circulation. Weather and climatic changes. Earth's heatbudget. Cyclones.

i. Earth's temperature and greenhouse effect .
ii. Paleo climate and recent climate changes.
iii. The Indian monsoon system.

Biosphere: Water cycle, Carbon cycle, Nitrogen cycle, Phosphorous cycle. The role of cyclesin maintaining a steady state.

Unit IV	Evolution	8

Nature of stratigraphic records, Standard stratigraphic time scale and introduction to the concept tof time in geological studies. Introduction to geochronological methods in their application ingeological studies. History of development in concepts of uniformitarianism, catastrophismandneptunism. Law of superposition and faunal succession. Introduction to the geology andgeomorphology of Indian subcontinent.

1. Time line of major geological and biological events.
2. Origin of life on Earth.
3. Role of the biosphere in shaping the environment.
4. Future of evolution of the Earth and solar system: Death of the Earth.

Unit V	**Disturbing the Earth – Contemporary dilemmas**	3
(a) Human population growth. (b) Atmosphere: Green house gas emissions, climate change, air pollution. (c) Hydrosphere: Fresh water depletion. (d) Geosphere: Chemical effluents, nuclear waste. (e) Biosphere: Biodiversity loss. Deforestation. Robustness and fragility of ecosystems.		
Text Books		
Reference Books	Planetary Surface Processes, H. Jay Melosh, Cambridge University Press, 2011. Consider a Spherical Cow: A course in environmental problem solving, John Harte. University Science Books Holme's Principles of Physical Geology. 1992. Chapman & Hall. Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3613

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will learn about the creation and structure of earth and universe	1	S
CO2	Students will gain knowledge about the various dynamics process involves in the solid earth and hydrosphere	2	S
CO3	Students will gain knowledge about the various dynamics process involves in the Atmosphere and Biosphere	2	S
CO4	Students will be able to understand the basic knowledge of the geology and geomorphology of Indian subcontinent	1	S
CO5	Students will learn about the distribution of earth.	2	S

CO-PO Mapping for PH3613

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	1	2	3	1	1	2	1	2	3	0	2	2
CO 2	2	1	2	1	2	2	1	2	1	3	2	3	0	1	2
CO 3	1	2	1	2	3	1	2	3	2	1	2	1	0	1	3
CO 4	2	2	2	1	2	2	1	2	2	1	2	1	0	1	1
CO 5	1	2	2	2	1	1	1	2	3	2	3	1	0	3	2
Avg	1.4	1.6	1.8	1.4	2.0	1.8	1.2	2.0	2.0	1.6	2.2	1.8	0.0	1.6	2.0

PH3614	Title: Applied Optics	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	PH3208	
Objectives	Student will learn optical phenomena and technology of Lasers, its characteristics, types of Lasers, and its applications in developing LED, Holography. Additionally they will learn about Photonics and Fibre optics.	
Expected Outcome	The students will be able to identify and use lasers and detectors, Holography, work with Optical fibres and their applications as well some advanced techniques in material characterization.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Sources and Detectors	9

Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients,Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Experiments on Lasers:

a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection usingHe-Ne or solid state laser.

b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.

c. To find the polarization angle of laser light using polarizer and analyzer

d. Thermal expansion of quartz using laser

Experiments on Semiconductor Sources and Detectors:

a. V-I characteristics of LED

b. Study the characteristics of solid state laser

c. Study the characteristics of LDR

d. Photovoltaic Cell

e. Characteristics of IR sensor

Unit II	Fourier Optics	7

(ii) Fourier Optics (6 Lectures)

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens

Experiments on Fourier Optics:

a. Fourier optic and image processing

1. Optical image addition/subtraction
2. Optical image differentiation
3. Fourier optical filtering
4. Construction of an optical 4f system

b. Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission andabsorption spectra, with wide application in atmospheric remote sensing, NMRspectrometry and forensic science.

Experiment:

To study the interference pattern from a Michelson interferometer as a function of mirrorseparation in the interferometer. The resulting interferogram is the Fourier transform of thepower spectrum of the source. Analysis of experimental interferograms allows one to determinethe transmission characteristics of several interference filters. Computer simulation can also bedone.

Unit III	Holography	6

(iii) Holography (6 Lectures)

Basic principle and theory: coherence, resolution, Types of holograms, white light reflectionhologram, application of holography in microscopy, interferometry, and character recognition

Experiments on Holography and interferometry:

1. Recording and reconstructing holograms
2. Constructing a Michelson interferometer or a Fabry Perot interferometer
3. Measuring the refractive index of air
4. Constructing a Sagnac interferometer
5. Constructing a Mach-Zehnder interferometer
6. White light Hologram

Unit IV	**Photonics:**	9
(iv) Photonics: Fibre Optics (9 Lectures) Optical fibres and their properties, Principal of light propagation through a fibre, The numericalaperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres,Fibre optic sensors: Fibre Bragg Grating **Experiments on Photonics: Fibre Optics** a. To measure the numerical aperture of an optical fibre b. To study the variation of the bending loss in a multimode fibre c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibrebymeasurements of its far field Gaussian pattern d. To measure the near field intensity profile of a fibre and study its refractive index profile e. To determine the power loss at a splice between two multimode fibre		
Unit V	**Polarized spectroscopy experiments**	7
Introduction to PL, lifetime measurements, thin film PL, LD, LCD, MOKE, MCD Experiments(optical alignment and discussion only)		
Text Books		
Reference Books	Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill. ASERS: Fundamentals & applications, K.Thyagrajan&A.K.Ghatak, 2010, Tata McGraw Hill Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for PH3614

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Student will learn optical phenomena and technology of Lasers, Semiconductor Sources and Detectors	2	S
CO2	Students will gain knowledge about Spatial frequency filtering, Fourier transforming property of a thin lens	3	S
CO3	Students are able to understand the basics about Holography and interferometry	2	S
CO4	Students will learn about Photonics and Fibre optics.	2	S
CO5	Students will able to understand about PL, lifetime measurements, thin film PL, LD, LCD, MOKE, MCD etc	3	Emp

CO-PO Mapping for PH3614

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	1	2	3	1	1	2	1	2	3	1	2	3
CO 2	2	1	2	1	2	2	1	2	1	3	2	3	2	1	2
CO 3	1	2	1	2	3	1	2	3	2	1	2	1	2	1	1
CO 4	2	2	2	1	2	2	1	2	2	1	2	1	2	1	2
CO 5	1	2	2	2	1	1	1	2	3	2	3	1	2	3	1
Avg	1	2	2	1	2	2	1	2	2	2	2	2	2	2	2

Specialization in Chemistry

CY3601	**Title: Quantum Chemistry**	**L T P C** **3 1 0 4**
Version No.	**1.0**	
Course Prerequisites		
Objectives	The focus of the quantum chemistry is the application of quantum mechanics in physical models & experiments of chemical system.	
Expected Outcome	The purpose of course to provide fundamentals of quantum mechan to problem of chemistry.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Quantum Chemistry**	10
Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization ofenergy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions,probability distribution functions, nodal properties, Extension to two and three dimensionalboxes, separation of variables, degeneracy.		
Unit II	**Vibrational Motion**	8
Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting upof Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy ofdiatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentumand z-component.		
Unit III	**Rotational Motion**	8
Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to,spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion ofsolution.		
Unit IV	**Qualitative treatment of Hydrogen atom**	8
Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödingerequation in spherical polar coordinates, radial part, and quantization of energy (only final energyexpression). Average and most probable distances of electron from nucleus.Setting up of Schrödinger equation for many-electron atoms (He, Li)		
Unit V	**Qualitative extension to H2**	7
Comparison of LCAO-MO and VB treatments of H2 (only wave functions, detailed solutionnot required) and their limitations. Refinements of the two approaches (ConfigurationInteraction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment ofhomonuclear and heteronuclear diatomic molecules (HF, LiH).		
Text Books	1. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition.	
Reference Books	2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H.Freeman and Co. 3. W.H. Freeman and Co.Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper'sIllustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.32	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3601

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be learning about basics of Quantum Chemistry.	1	S
CO2	Students will be gaining knowledge on vibrational motion.	2	S
CO3	Students will be gaining knowledge on Rotational motion.	1	S
CO4	Students will be gaining knowledge on Qualitative treatment of hydrogen atom.	2	S
CO5	Students will be gaining knowledge on Qualitative extension to hydrogen.	2	S

CO-PO Mapping for CY3601

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	2	1	1	2
CO 3	1	1	2	2	1	1	2	1	1	2	2	2	1	1	1
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.2	1.2	1.2	1.8	1.2	1.8	1.2	1.0	1.4

CY3602	**Course Title: Instrumental Methods of Chemical Analysis**	**L T P C** **3 1 0 4**
Version No.	**1.0**	
Course Prerequisites		
Objectives	To gives basic knowledge on instrumental methods of chemical analysis.	
Expected Outcome	To measure the accuracy of analytical data on the basic of interpretatio	
Unit No.	**Unit Name**	**No. of hours (per Unit)**
Unit I	**Introduction to spectroscopic methods of analysis**	8

.

Molecular spectroscopy:

Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources),separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution).

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N).

Unit II	**Separation Techniques**	8
Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis(use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use withDNA analysis.		
Unit III	**Elemental Analysis**	8
Mass spectrometry (electrical discharges).Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.Excitation and getting sample into gas phase (flames, electrical discharges, plasmas),Wavelength separation and resolution (dependence on technique), Detection of radiation(simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionicspecies, matrix effects, other interferences)		
Unit IV	**NMR Spectroscopy**	6
: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spincoupling,Applications.		
Unit V	**Electroanalytical Method**	6
Potentiometry &Voltammetry ,Radiochemical Methods, X-ray analysis and electron spectroscopy (surface analysis)		

Text Books	Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler,and Stanley Crouch (ISBN 0-495-01201-7)
Reference Books	Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.W.J. Moore: Physical Chemistry.
Mode of Evaluation	
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3602

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to know the working of various instruments.	1	S
CO2	Students will be able to describe the various tecniques of separations	1	S
CO3	Students will be gaining knowledge on spectra and quantify information about the atoms and molecules.	1	S
CO4	Students able to know the principle of various instruments.	1	S
CO5	Students able to know the electro analytical methods.	2	S

CO-PO Mapping for CY3602

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	2	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
CO 4	1	2	1	1	1	2	1	1	1	2	1	2	2	1	1
CO 5	2	1	1	1	2	1	1	1	1	1	1	2	1	1	1
Avg	1.2	1.2	1.4	1.2	1.4	1.2	1.0	1.4	1.2	1.8	1.2	1.6	1.2	1.0	1.4

CY3517	Title: Environmental Chemistry	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites		
Objectives	Environmental chemistry scientific study of the chemical and biochemical phenomena that occour in natural places	
Expected Outcome	To study the environmental behaviour of natural and anthropoge chemicals or various types of pollutions.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Fundamentals of Environmental Chemistry	8
Atomic structure, electronic configuration, periodic properties of elements (ionization potential, electron affinity and electronegativity), types of chemical bonds (ionic, covalent, coordinate and hydrogen bonds); mole concept, molarity and normality, quantitative volumetric analysis. Thermodynamic system; types of chemical reactions; acids, bases and salts, solubility products; solutes and solvents; redox reactions, concepts of pH and pE, electrochemistry, Nernst equation, electrochemical cells.		
Unit II	Basic Concepts of Organic Environmental Chemistry	8
Basic concepts of organic chemistry, hydrocarbons, aliphatic and aromatic compounds, organic functional groups, polarity of the functional groups, synthesis of xenobiotic compounds like pesticides and dyes, synthetic polymers.		
Unit III	Atmospheric Chemistry	10
Composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), aerosols; chemistry of acid rain, case studies; reactions of NO_2 and SO_2; free radicals and ozone layer depletion, role of CFCs in ozone depletion		
Unit IV	Water Chemistry	7
Chemical and physical properties of water; alkalinity and acidity of water, hardness of water, calculation of total hardness; solubility of metals, complex formation and chelation; colloidal particles; heavy metals in water.		
Unit V	Soil chemistry	8
Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium in soil; phenolic compounds in soil.		
Text Books	1. Beard, J.M. 2013. *Environmental Chemistry in Society* (2nd edition). CRC Press. 2. Boeker, E. &Grondelle, R. 2011. *Environmental Physics: Sustainable Energy and ClimateChange*. Wiley.	
Reference Books	1. Connell, D.W. 2005. *Basic Concepts of Environmental Chemistry* (2nd edition). 2. CRC PressForinash, K. 2010. *Foundation of Environmental Physics*. Island Press. 3. Girard, J. 2013. *Principles of Environmental Chemistry* (3rd edition). Jones & Bartlett.	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3512

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will gain knowledge on fundamentals of environmental chemistry.	1	S
CO2	Students will gain knowledge on basic concepts of organic environmental chemistry.	2	S
CO3	Students will gain knowledge on atmospheric chemistry.	1	S
CO4	Students will gain knowledge on water chemistry.	2	S
CO5	Students will gain knowledge on soil chemistry.	1	S

CO-PO Mapping for CY3512

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	2	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	2	2	1	1	2	1	1
CO 3	1	1	2	2	1	1	1	2	1	1	2	2	1	1	1
CO 4	2	1	1	1	1	2	1	1	1	2	1	2	2	1	2
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2
Avg	1.2	1.0	1.4	1.4	1.4	1.2	1.0	1.4	1.4	1.6	1.2	1.6	1.4	1.0	1.4

CY3611	**Title: Molecules of Life**	L T P C 4 0 0 4
Version No.	**1.0**	
Course Prerequisites		
Objectives	To understand the basics of life molecules that incudes carbohydrates, lipids, proteins, DNA & RNA.	
Expected Outcome	The study will be useful to know the importance of biological systems.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Carbohydrates**	8
Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.		
Unit II	**Lipids**	8
Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).		
Unit III	**Enzymes and correlation with drug action**	10
Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non- competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring.		
Unit IV	**Nucleic Acids**	7
Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.).		
Unit V	**Vitamins and Food Additives**	8
Vitamins – Classification, units of measurement, sources, functions and deficiency diseases caused by following vitamins: Fats soluble vitamins – Vitamin A, D, E and K Water soluble vitamins – Vitamin C and B-complex 3. Vitamins and minerals structure general causes of loss in food. Fortifications, Enrichment and Restoration. Food Colorants and Additives (if time permits) • Natural and artificial colorants • Roles of commonly used food preservatives		
Text Books	1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Reference Books	1. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for CY3611

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be gaining knowledge on classification and properties of Carbohydrates.	1	S
CO2	Students will be gaining knowledge on Lipids and its importance.	1	S
CO3	Students will be gaining knowledge on enzymes and its correlation with drugs.	2	S
CO4	Students will be gaining knowledge on structure and function of nucleic acids.	1	S
CO5	Students will be gaining knowledge on vitamins and food additives.	2	S

CO-PO Mapping for CY3611

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	1	1	1	2	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	1
CO 3	1	1	2	2	1	1	1	2	1	2	2	2	1	2	2
CO 4	1	2	1	1	2	1	1	2	1	2	1	2	2	1	1
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	2	2
Avg	1.0	1.4	1.4	1.2	1.6	1.2	1.0	1.6	1.2	1.8	1.2	1.6	1.2	1.4	1.4

CY3612	Title :Biochemistry	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites		
Objectives	The course aims to provide and advanced understanding of the core principles & topics of biochemistry.	
Expected Outcome	Explain what biochemistry is about & appreciate its central role in science. Understand the relationship to health & diseases & to medicines	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	The Foundations Of Biochemistry	8
Cellular and chemical foundations of life.		
Unit II	Water	7
Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment		
Unit III	Carbohydrates and Glycobiology	10
Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates		
Unit IV	Lipids & Amino Acids	8
Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments, Structure and classification, physical, chemical and optical properties of amino acids		
Unit V	Nucleic acids &Vitamins	8
Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers, Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis.		
Text Books	1. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.	
Reference Books		
Mode of Evaluation		
Recommendation by Board of Studies on	13-06-2018	
Date of approval by	13-07-2018	

Course Outcome for CY3612

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None(*Use , for more than One*)
CO1	Students will be able to gain knowledge on basics of Biochemistry.	1	S
CO2	Students will be gaining knowledge of water.	2	S
CO3	Students will be gaining knowledge of carbohydrates and structure .	2	S
CO4	Students will be gaining knowledge of Lipid and amino acids	1	S
CO5	Students will be gaining knowledge of vitamins and nucleic acids	1	S

CO-PO Mapping for CY3612

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	2
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	1
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	1
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	2
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.0	1.2	1.2	1.8	1.2	1.6	1.2	1.0	1.4

CY3613	Title: Research Methodology for Chemistry	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites		
Objectives	The process used to collect information & data for purpose for making decisions. The methodology may include publication research techniques, interview & survey etc	
Expected Outcome	Methodology is the systematic theoritical analyis of the methods applied to a field of study	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Literature Survey	10

Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books,currentcontents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index,Author Index, Formula Index, and other Indices with examples.

Digital: Web resources, E-journals, Journal access, TOC alerts, Harticles,Citationindex,Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groupsand52communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry,Wiki- Databases, ChemSpider, Science DirectSciFinder,Scopus.
Information Technology and Library Resources: The Internet and World Wide Web.
Internet resources for chemistry. Finding and citing published information.

Unit II	Methods of Scientific Research and Writing Scientific Papers	8

Reporting practical and project work. Writing literature surveys and reviews. Organizing poster display. Giving an oral presentation.Writingscientific papersjustification for scientific contributions, bibliography, descriptionof methods, conclusions, the need for illustration, style, publications of scientific work.Writing ethics. Avoiding plagiarism.

Unit III	Chemical Safety and Ethical Handling of Chemicals	8

Safe working procedure and protective environment, protective apparel, emergencyprocedure and first aid, laboratory ventilation. Safe storage and use of hazardouschemicals,procedure for working with substancesthat post hazards,flammableor explosive hazards,procedures for working with gases at pressures above or below atmospheric – safe storageand disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals,procedure for laboratory disposal of explosives, identification, verification and segregation oflaboratory waste, disposal of chemicals in the sanitary sewer system,incinerationandtransportation of hazardous chemicals.

Unit IV	Data Analysis	7

The Investigative Approach: Making and Recording Measurements. SI Units and theiruse.Scientific method and design of experiments.*Analysis and Presentation of Data:* Descriptive statistics. Choosing and using statistical tests.Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting,fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals,General polynomial fitting, linearizing transformations, exponential function fit, *r* and it's a base. Basic aspects of multiple linear regression analysis.

Unit V	Electronics	8

Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers forelectrochemical instruments. Elementary aspects of digital electronics.

Text Books	1. Hibbert, D. B. & Gooding, J. J. (2006) *Data analysis for chemistry*. OxfordUniversityPress..
Reference Books	1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011).
Mode of Evaluation	
Recommendation by Board of Studies on	13-06-2018
Date of approval by the Academic Council	13-07-2018

Course Outcome for CY3613

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to gain knowledge on Literary survery and their sources.	1	S
CO2	Students will be gaining knowledge on methods of scientific research.	2	S
CO3	Students will be gaining knowledge on chemical safety and ethical handling of chemicals.	2	S
CO4	Students will be gaining knowledge on Data Analysis.	1	S
CO5	Students will be gaining knowledge on electronic circuits.	1	S

CO-PO Mapping for CY3613

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
CO 2	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2
CO 3	1	1	2	2	1	1	1	1	1	2	2	2	1	1	2
CO 4	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1
CO 5	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1
Avg	1.0	1.0	1.4	1.2	1.4	1.0	1.0	1.2	1.2	1.8	1.2	1.6	1.2	1.0	1.4

MA3601	Title: Partial Differential Equations	L T P C 4 2 0 5
Version No.	1.0	
Course Prerequisites	MA3207 ,MA3107	
Objectives	To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.	
Expected Outcome	Graduates will able to identify, formulate and solve engineering problems.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Introduction of PDE**	9
Linear partial differential equations of first order.Non linear PDE of first order, Charpit's method, Lagrange's methods.		
Unit II	**Classification of PDE**	9
Classification of partial differential equations of second order and canonical form.		
Unit III	**Solution of second order PDE**	6
Linear Homogeneous Partial differential equations of n^{th} order with constant coefficients, Rules for finding the complementary function, Rules for finding the Particular Integral, Short method to find out P.I. in Particular case.		
Unit IV	**Variable separable solution**	9
Solution of one and two dimension solution by separation of Variables, Solution of heat equations in one and two dimensions by method of separation of variables.		
Unit V	**Wave equations**	7
Equation of vibrating string, Solution of Wave equations.		
Text Books	**TynMyint-U** and **LokenathDebnath,** *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006	
Reference Books	**Ioannis P Stavroulakis**and**Stepan A Tersian**, *Partial Differential Equations: An Introduction with Mathematica and MAPLE*, World Scientific, Second Edition, 2004	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3601

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will learn to solve the linear partial Differential equation of first order and also learn the solution by specific method (Charpit's method ,Lagrange's methods.	3	Emp
CO2	Students will be able to work with partial differential equation and students learns the classifications of partial differential equation of second order and canonical form .	2	S
CO3	Students will learn to solve linear homogeneous partial differential equation of nth order with constant coefficients .learn methods of finding CF and find PI by short method .	2	S
CO4	Students will learn separation of variable method and will be able to apply it for finding the solution of heat equation in one and two dimensions.	3	Enp
CO5	Students will learn to solve the wave equations and equation of vibrating string.	2	S

CO-PO Mapping for MA3601

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	3	2	1	2	3	1	2	3	2	2	2
CO 2	3	1	3	3	2	3	2	1	1	2	2	3	3	3	2
CO 3	2	3	2	3	3	1	2	2	2	1	2	3	1	3	1
CO 4	2	2	1	3	2	2	3	3	3	3	3	2	2	3	2
CO 5	3	3	2	2	3	3	1	3	2	3	1	2	3	2	2
Avg	2.6	2.4	2.0	2.6	2.6	2.2	1.8	2.2	2.2	2.0	2.0	2.6	2.2	2.6	1.8

MA3602	Title: Complex Analysis	L T P C 3 2 0 5
Version No.	1.0	
Course Prerequisites	MA3306	
Objectives	To impart the knowledge of complex function and complex integration.	
Expected Outcome	Students will be able to describe the analytic function and properties. Students will also able to solve complex integration ..	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Analytic function	10
Functions of a complex variable, Concepts of limit, Continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations (Cartesian and polar form), Harmonic functions, Orthogonal system.		
Unit II	Complex Integration	9
Complex Integration, Line integral, Cauchy's fundamental theorem, Cauchy's integral formulas.		
Unit III	Power series	8
Method of expansion of a function, Taylor theorem and Laurent theorem.		
Unit IV	Singularities and Residue	7
Zeros and singularities of analytic function and related theorems, Residues and their determination, Cauchy residue theorem.		
Unit V	Contour Integration	6
Evaluation of proper and improper integrals by calculus of residues.		
Text Books	James Ward Brown and Ruel V. Churchill, Complex Variables and Applications (Eighth Edition), McGraw – Hill International Edition, 2009.	
Reference Books	Joseph Bak and Donald J. Newman, *Complex analysis* (2nd Edition), Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3602

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations.	2	S
CO2	Students will be able to apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra and use anti derivatives to compute line integrals.	3	S
CO3	Express complex-differentiable functions as power series. Analyze sequences and series of analytic functions and types of convergence. Apply the theory into application of the power series expansion of analytic functions	2	S
CO4	Students will gain knowledge on functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.	3	S
CO5	Students will be able to understand the uses of improper integrals in various situations. Understand the basic methods of complex integration and its application in contour integration	2	S

CO-PO Mapping for MA3602

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	2	3	1	1	3	2	1	1	1	1	2	1	2	3	2
CO 2	1	2	1	2	3	2	1	3	2	1	2	2	1	2	2
CO 3	1	1	2	1	1	2	3	2	2	1	1	1	2	3	1
CO 4	2	3	1	2	1	2	2	3	1	1	2	2	1	2	2
CO 5	3	1	2	2	2	1	1	2	1	1	1	3	2	1	1
Avg	1.8	2.0	1.4	1.6	2.0	1.8	1.6	2.2	1.4	1.0	1.6	1.8	1.6	2.2	1.4

MA3611	Title: Metric Space	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	MA3306	
Objectives	To impart the knowledge of real metric space .	
Expected Outcome	Students will be able to describe the metric space and properties of me space.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction of metric space	9
Metric spaces: definition and examples Open and closed balls, neighbourhood open set, interior of a set, Limit point of a set, closed set, diameter of a set.		
Unit II	Completeness of Metric Spaces	9
Sequences in metric spaces, Cauchy sequences. Completeness of Metric Spaces.		
Unit III	Continuity in metric space	8
continuous mappings, sequential criterion and other characterizations of continuity.		
Unit IV	Connectedness	7
Connectedness, connected subsets of **R,** connectedness and continuous mappings.		
Unit V	Compactness	7
Compactness, compactness and boundedness, continuous functions on compact spaces.		
Text Books	SatishShirali&Harikishan L. Vasudeva, Metric Spaces, Springer Verlag London (2006) (First Indian Reprint 2009)	
Reference Books	[1] S. Kumaresan, Topology of Metric Spaces, Narosa Publishing House, Second Edition 2011. [2] G. F. Simmons, Introduction to Topology	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3611

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to distinguish between open and closed balls in a metric space and be able to determine them for given metric space.	2	S
CO2	Students will learn convergence for sequence in a metric space and determine whether a given sequence in metric space convergence.	3	S
CO3	Students will be able to understand the definition of Continuity for functions from Rn to Rm and determine whether a given function from Rn to Rm is continuous .	2	S
CO4	Students will be able to understood the basic results about completeness, connectedness and convergence within these structures.	3	Emp
CO5	Students will learn to find open and closed sets, adherent points, convergent and Cauchy convergent sequences, complete spaces ; compactness and connectedness etc.,	2	None

CO-PO Mapping for MA3611

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	1	2	3	2	3	1	2	3	3	2	1	2
CO 2	2	3	1	3	2	2	3	2	2	3	3	2	2	1	2
CO 3	3	2	3	1	3	1	3	2	3	2	2	1	3	2	2
CO 4	2	3	2	2	2	2	2	1	3	1	3	3	2	3	2
CO 5	3	2	1	3	1	3	2	3	1	3	1	2	3	3	1
Avg	2.6	2.4	2.0	2.0	2.0	2.2	2.4	2.2	2.0	2.2	2.4	2.2	2.4	2.0	1.8

MA3612	Title: Advance Mechanics	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	MA3306	
Objectives	To impart the knowledge ofthe basic requirements for their higher studies.	
Expected Outcome	Learn different ways of solving second order differential equations and familiarized with singular points.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Statics in space	10
Forces in three dimensions, Reduction to a force and a couple, Equilibrium of a system of particles, Central axis and Wrench, Equation of the central axis, Resultant wrench of twowrenches;		
Unit II	Motion of a rigid body	9
Moments and products of inertia of some standard bodies, Momenta ellipsoid, Principal axesand moments of inertia.		
Unit III	Equation of continuity in Coordinates	8
Lagrangian and Eulerian approaches, Material and convective derivatives, Velocity of a fluidat a point, Equation of continuity in Cartesian, cylindrical polar and spherical polarcoordinates, Cylindrical and spherical symmetry, Boundary surface		
Unit IV	Equations of motion	6
Euler's equations of motion in.		
Unit V	Two dimensional flow	7
Stream function, Complex potential, Basic singularities: Sources, sinks, doublets, complexpotential due to these basic singularities; Image system of a simple source and a simpledoublet with regard to a line and a circle, MilneThomson circle theorem. Cartesiancoordinates,;Bernoulli's equation, Impulsive motion		
Text Books	1. Michel Rieutord (2015). *Fluid Dynamics An Introduction.* Springer.	
Reference Books	1. A. S. Ramsay (1960). *A Treatise on Hydromechanics, Part-II Hydrodynamics.* G. Bell& Sons. 2. F. Chorlton (1967). *A Textbook of Fluid Dynamics.* CBS Publishers.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3612

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will be able to understand the reduction to a force and a couple, Equilibrium of a system of particles	2	S
CO2	Students will be able to understand the concepts of Momentum ellipsoid, Principal axes and moments of inertia	3	S
CO3	Students will gain complete knowledge of Material and convective derivatives, Velocity of a fluid at a point, Equation of continuity in Cartesian, cylindrical polar and spherical polar coordinates	2	S
CO4	Students will be able to understand Cartesiancoordinates,; Bernoulli's equation, Impulsive motion.	2	S
CO5	Students will be able to understand Milne Thomson circle theorem. Cartesiancoordinates,; Bernoulli's equation, Impulsive motion	3	S

CO-PO Mapping for MA3612

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO 1	3	2	2	2	3	2	1	3	2	1	2	2	3	3	3
CO 2	3	2	2	3	3	2	2	3	1	2	2	3	3	3	2
CO 3	3	2	1	3	2	2	1	3	1	2	1	2	2	3	2
CO 4	3	2	2	3	1	2	2	3	2	3	2	3	3	3	3
CO 5	3	2	1	2	2	1	1	2	1	2	1	2	2	2	2
Avg	3.0	2.0	1.6	2.6	2.2	1.8	1.4	2.8	1.4	2.0	1.6	2.4	2.6	2.8	2.4

MA3613	Title: Number Theory	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Demonstrate knowledge and understanding of topics including, divisibility, prime numbers, congruence, quadratic reciprocity, Diophantine equations.	
Expected Outcome	Learn methods and techniques used in number theory.	
Unit No.	Unit Title	No. of hours (Per Unit)
Unit I	Division algorithm	8
The division algorithm, The gcd , the Euclidean algorithm , Diophantine equations $ax + by = c$, the fundamental theorem of arithmetic .		
Unit II	Theory of congruencies	8
The theory of congruencies, binary and decimal representations of integers , linear congruence and Chinese remainder theorem , Fermat's theorem ,Wilson's theorem .		
Unit III	Number theoretic function	8
Number theoretic function , Tau and sigma function , the Mobius inversion formula, the greatest integer function , Euler's phi function , properties of phi function , Euler's theorem .		
Unit IV	Composite number	8
The order of an integer molulon , primitive roots for primes , composite numbers having primitive roots the theory of indices , continued fraction, approximation of irrationals by rationals .		
Unit V	Dirchlet product	8
Definition and properties of the Dirichlet product.		
Text Books	**David M. Burton**, *Elementary Number Theory* (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.	
Reference Books	**Neville Robinns,** *Beginning Number Theory* (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3613

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will learn about the Euclidean algorithm ,Diophantine equations.	2	S
CO2	Students will be able to understand the theory of congruencies, binary and decimal representations of integers , linear congruence and Chinese remainder theorem , Fermat's theorem ,Wilson's theorem.	3	S
CO3	Students Will learn about Tau and sigma function , the Mobius inversion formula.	3	S
CO4	Students will be able to know the concept of order of an integer molulon , primitive roots for primes , composite numbers.	2	S
CO5	Students learn concept of the Dirichlet product.	3	S

CO-PO Mapping for MA3613

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	1	3	1	3	1	3	1	2	1	2	2	3
CO 2	2	3	1	3	1	1	3	3	2	2	1	2	2	3	1
CO 3	3	3	2	2	2	2	2	2	3	2	3	2	3	2	2
CO 4	2	2	3	3	3	1	2	3	2	2	2	2	1	3	3
CO 5	1	3	2	3	2	1	3	2	3	2	3	2	3	2	2
Avg	2.2	2.6	2.2	2.4	2.2	1.2	2.6	2.2	2.6	1.8	2.2	1.8	2.2	2.4	2.2

MA3614	Title : The Theory of Rings	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	MA3407	
Objectives	The objectives of this course are to give some basic definitions, state several fundamental properties and a few examples of rings.	
Expected Outcome	The knowledge obtained from study of advanced ring theory motivates to do further research work in the theory of rings.	
Unit No.	Unit Title	No. of hours (Per Unit)
Unit I	Introduction of Ring	9
Ring definition and examples, sub rings, Imbedding of rings,Direct and discrete direct sum of rings,Product of rings.		
Unit II	Ideals	7
Ideals, product of two Ideals, prime ideals , maximal ideals , principal ideal , quotient ring.		
Unit III	Polynomials Ring	8
Polynomials rings Euclidean theorem , factor theorem, irreducible polynomials.		
Unit IV	Field Extension	9
Introduction of Extension Field, Algebraic Extension, Roots of polynomials.		
Unit V	Splitting Field	7
Splitting fields and construction by edge and compass.		
Text Books	N. H. McCoy: The Theory of Rings.	
Reference Books	Anderson and Fuller: Rings and Categories of Modules. 3. I. S. Luthar and I. B. S. Passi: Algebra Volume 2: Rings.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2018	
Date of approval by the Academic Council	13-07-2018	

Course Outcome for MA3614

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Emp)/ Skill(S)/ Entrepreneurship (Enp)/ None (*Use , for more than One*)
CO1	Students will learn about Ring , sub rings embedding of rings and some properties of rings and apply these properties in problem solving.	2	S
CO2	Students will be able to understand the definition of Ideals , product of two ideals , prime ideals, maximal ideals , principle ideals and about quotient ring .	3	S
CO3	Students Will learn about definition and properties of Polynomial rings,euclidean theorem , factor theorem , irreducible polynomials	2	S
CO4	Students will be able to know the concept of extension field , algebraic extension , Roots of polynomial and apply this concept in problem solving .	2	Enp
CO5	Students learn concept of Splitting fields and some theorems on it and learn about constructible number, construction by edge and compass	3	None

CO-PO Mapping for MA3614

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	2	3	2	3	2	2	3	3	2	2	1
CO 2	3	3	2	3	2	2	3	2	2	3	3	2	2	1	2
CO 3	2	2	3	1	3	1	3	2	3	2	2	1	2	2	1
CO 4	3	3	2	2	2	2	2	1	3	1	3	2	2	2	2
CO 5	3	2	1	2	1	3	2	3	1	3	1	2	3	3	2
Avg	2.8	2.4	2.2	2.0	2.0	2.2	2.4	2.2	2.2	2.2	2.4	2.0	2.2	2.0	1.6