



SACRED HEART COLLEGE (AUTONOMOUS)

Tirupattur – 635 601, Tamil Nadu, S.India

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Ready for
Every Good Work

A Don Bosco Institution of Higher Education, Founded in 1951 * Affiliated to Thiruvalluvar University, Vellore * Autonomous since 1987

Accredited by NAAC (4th Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade

B.Com Course Structure

S. No	Course Code	Course	Number of Credits	Hours	CA	SE	Total
SEMESTER I							
1	LT114	Part I Language I – Tamil 1	3	5	50	50	100
2	LE115BT	Part II English I	2	5	50	50	100
3	C116	Part III MC – Principles of Accountancy	5	5	50	50	100
4	C117	MC – Environmental Aspects of Business	5	5	50	50	100
5	AE106	Allied I Principles of Economics I	4	6	50	50	100
6	SK104	Part IV Communication Skills	1	2	100		100
7	VE105A/B	Christian Religion I / Value Education I	1	2	100		100
8	CE103	Communicative English	1		100		100
9	LE115BP	English Lab	1		50	50	100
		Total	23	30			

S. No	Course Code	Course	Number of Credits	Hours	CA	SE	Total
SEMESTER II							
1	LT214	Part I Language II	3	5	50	50	100
2	LE215BT	Part II English II	2	5	50	50	100
3	C216	Part III MC – Financial Accounting I	5	5	50	50	100
4	C217	MC – Banking and Insurance	5	5	50	50	100
5	AE206	Allied I Principles of Economics II	4	6	50	50	100
6	SK204	Part IV Leadership Skills	1	2	100		100

7	VE205A/B	Christian Religion II / Value Education II	1	2	100		100
8	CE203	Communicative English	1		100		100
9	LE215BP	English Lab	1		50	50	100
		Total	23	30			

S. No	Course Code	Course	Number of Credits	Hours	CA	SE	Total
SEMESTER III							
1	C325	Part III MC – Financial Accounting II	5	5	50	50	100
2	C326	MC – Principles of Marketing	5	5	50	50	100
3	C327	MC – Mercantile Law	4	4	50	50	100
4		Allied I Managerial Economics	4	6	50	50	100
5	AM310A	Allied II Business Mathematics	4	6	50	50	100
6	VE306	Part IV Human Rights	1	2	100		100
7	SK304	Technical Skills	1	2	100		100
8	CO-DED	Part V Out Reach Activity (DEEDS)					
9	CO-SHE	Co-Curricular Activity (SHELTERS)					
		Total	24	30			

S. No	Course Code	Course	Number of Credits	Hours	CA	SE	Total
SEMESTER IV							
1	C424	Part III MC – Corporate Accounting	5	5	50	50	100
2	C425	MC – Cost Accounting	5	5	50	50	100
3	C426	MC – Business Management	4	4	50	50	100
4		Allied I International Economics	4	6	50	50	100
5	AM409A	Allied II Business Statistics	4	6	50	50	100
6	VE406	Part IV Environmental Science	1	2	100		100
7	SK404	Employability Skills	1	2	100		100
8	CO-DED	Part V Out Reach Activity (DEEDS)	2				
9	CO-SHE	Co-Curricular Activity (SHELTERS)	2				
		Total	28	30			

S. No	Course Code	Course	Number of Credits	Hours	CIA	SE	Total
SEMESTER V							
1	C541	Part III MC – Advanced Cost Accounting	6	6	50	50	100
2	C542	MC – Income Tax Law and Practice I	5	5	50	50	100
3	C543	MC – Financial Management	5	5	50	50	100
4	C544A/B/C	ME 1 1. Advanced Corporate Accounting 2. Indirect Taxation 3. Business Logistics	4	6	50	50	100
5	C545A/B	SS 1 1. Computer Fundamentals and E-Commerce 2. Entrepreneurship	4	6	50	50	100
6	NCO504	Part III Non Major Elective I	1	2	100	--	100
7		Part VI - Self-Study Paper 1. Rural Banking 2. Office Management 3. Customer Relationship Management	1*				
8		Summer Internship / Mini Project	2*				
		Total	25 + 3*	30			
SEMESTER VI							
S. No	Course Code	Course	Number of Credits	Hours	CIA	SE	Total
1	C647	Part III MC – Management Accounting	6	6	50	50	100
2	C648	MC – Income Tax Law and Practice II	5	5	50	50	100
3	C649	MC – Human Resource Management	5	5	50	50	100
4	C650A/B/C	ME 2 1. Practical Auditing 2. Industrial Relations and Labour Laws 3. Social Entrepreneurship	4	6	50	50	100
5	C651A/B	SS 2 1. Computerized Accounting 2. Modern Salesmanship	4	6	50	50	100
6	NCO604	Part III Non Major Elective II	1	2	100	--	100
7		Part VI - Self-Study Paper 1. Retail Marketing Management 2. Knowledge Management 3. Fundamentals of Investment	1*				
		Total	25 + 1*	30			
SEMESTER - I PART III- MAJOR CORE							

ENVIRONMENTAL ASPECTS OF BUSINESS

Course Code	C117	Credit	5
Instruction Hours per Week	5	Marks	CIA (50) / SE (50)
Course Objective	<ul style="list-style-type: none"> • To make the students to acquire basic knowledge about the business environment • To impart knowledge on the various environmental aspects in the midst of which a business has to be organized. • To enable the students to understand the difference between Money market and Capital Market • To expose students to Money Market, Capital Market, Stock Exchange and SEBI • To create awareness on various ethical issues in business and consumer rights. 		

Course Outcomes

After studying this course, students would be able to

CO. No.	CO- Statement	Cognitive Levels
CO 1	Students will acquire the basic knowledge of business environment	K4
CO 2	The students will know the various internal and external factors influencing a business concern.	K4
CO 3	The students will know the importance of different financial markets and understand their functioning.	K4
CO 4	Students will know various aspects of stock market and motivates them to acquire knowledge on stock market investment	K5
CO 5	The students will be able to evaluate the ethical considerations in operation of business enterprises. They will also know the rights and duties of consumers	K3

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	1	1	2	1	2	2	2	1	1	1	1	1	1.33
2	1	1	2	2	2	2	2	2	1	2	1	1	1.58
3	2	2	3	2	2	3	3	2	2	2	2	2	2.25
4	2	2	3	2	3	3	3	2	2	3	2	2	2.42
5	2	2	3	2	3	2	3	2	2	3	3	2	2.42
Mean Overall Score												2.00	
Result												Medium	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)	Term End Exam (100)
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	I CA (50)	II CA (50)	Marks Allotment
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I : Nature and Objectives of Business:

Classification of Business, Industries – characteristics of business – Social and Economic objectives of business.

Unit – II: Business Environment:

Economic, Political, Government, Natural, Technological, Social / Cultural and Demographic Environments – their role in business.

Unit – III Money and Capital Markets:

Nature, constituents and its importance – Functions of money market, Indian money market - Indian Capital Market and its development.

Unit – IV Stock Exchange and its Regulation:

Importance and objectives – NSE – features and objectives – Listing and its advantages -Dematerialization and its advantages – SEBI – powers and functions. SENSEX and NIFTY (meaning and examples only)

Unit – V Business and Society:

Ethical Principles – Social Responsibility of business to various segments – CSR practices in India. Consumerism – Consumer protection and consumer rights.

Text Book

1. Francis Cherunilam, Business Environment, Himalaya Publishing House, New Delhi

Reference Books

1. Gupta C.B. Business Organization and Management, S Chand & Co. New Delhi.
2. Y.K. Bhushan, Fundamentals of Business Organization, Sultan Chand & Sons, New Delhi
3. Sharma R.K. & Gupta Shashi K., Business Organization and Management, Kalyani Publishers.
4. Mishra N., Fundamentals of Business Organization, Allied Publication.

Note: Latest Edition of Text Books may be used.

SEMESTER - VI
PART III- MAJOR ELECTIVE II

SOCIAL ENTREPRENEURSHIP

Course Code	C650C	Credit	4
Contact Hours per Week	6	Marks	CIA (50) / SE (50)
Course Objectives	<ul style="list-style-type: none"> • Understand the social entrepreneurship process, framework and social activism. • Examine the concepts underpinning social entrepreneurship to gain a comprehensive understanding of the opportunities. • Identify and evaluate the social entrepreneurial opportunities • Comprehend the concept of social innovation, environmental ethics and sustainability to evolve a successful model of social innovation. • Critically assess the strategic and operational issues faced by those who create and manage social enterprises in the process of bringing a successful model of social entrepreneurship. 		

Course Outcomes

After studying this course, students would be able to

CO. No.	CO- Statement	Cognitive Levels
CO 1	Understand the social entrepreneurship process, framework and social activism.	K2
CO 2	Examine the concepts underpinning social entrepreneurship to gain a comprehensive understanding of the opportunities.	K3
CO 3	Identify and analyze the social entrepreneurial opportunities	K4
CO 4	Comprehend the concept of social innovation, environmental ethics and sustainability to evaluate and evolve a successful model of social innovation.	K5
CO 5	Critically assess the range of strategic and operational issues faced by those who create and manage social enterprises to create a successful model of social entrepreneurship.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	3	2	1	2	2	1	3	1	3	3	2	2.17
2	3	2	3	1	2	2	1	2	1	3	2	2	2.00
3	3	2	3	2	2	2	1	3	1	3	2	2	2.17
4	3	3	3	2	2	2	1	3	1	3	2	2	2.25
5	3	2	2	2	2	2	1	3	1	3	3	2	2.17
Mean Overall Score												2.15	
Result												High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

UNIT I: SOCIAL ENTREPRENEURSHIP

Social entrepreneur - social entrepreneurship - social enterprises. Characteristics of Social Entrepreneurship - Explicitly formulated mission to create and sustain social value and to benefit the communities. Social entrepreneur – factors impacting transformation into social entrepreneur. Differences between Business and Social entrepreneur - Entrepreneurship and Social Entrepreneurship. Challenges in Social Entrepreneurship - Social Entrepreneurship in developing countries and in India.

UNIT II: THE SOCIAL ENTREPRENEURSHIP PROCESS

The Timmons Model of the Entrepreneurship Process - The PCDO (The People, Context, Deal, and opportunity) frame work - The Social Entrepreneurship Frame work - Sources of Social Entrepreneurship - Public Sector, Private Sector, Voluntary Sector - Qualities and Skills of Social Entrepreneur. Boundaries of Social Entrepreneurship – Social service provision, Social activism.

UNIT III: OPPORTUNITIES FOR SOCIAL ENTREPRENEURS

Opportunity Recognition & Study on the Source and Discovery of Social Opportunities - Entrepreneurial Opportunity Evaluation: A Discrete Choice Analysis of Financial and Social Entrepreneurial Opportunity Attributes - Modelling the Social Venturing Process. Enterprise launching and its procedures – start-ups – incubation – accessing venture capital – CSR funds - PPP Cooperative strategy: Building networks, partnership and alliance

UNIT IV: SOCIAL INNOVATION AND SUSTAINABILITY

Social Innovation - Concept of Sustainable Development and its importance - Factors affecting sustainable development - Environmental costs and its economic value. Limits of Growth - Silent Spring - Kyoto Protocol - Dimensions of sustainable development - Environmental ethics - The rationale for MDGs and its link with Sustainable Development - Need and Importance of sustainability in social innovation - Case studies from national and international efforts in the area of social innovation and its sustainability. Emerging trends in sustainability and its applicability in social innovation.

UNIT V: SUCCESSFUL SOCIAL ENTREPRENEURSHIP INITIATIVES

Bangladesh Rural Advancement Committee (BRAC) - The Grameen Bank (GB) - The Self Employment Women's Association (SEWA) - Aravind Eye Hospital - Barefoot College - Bhartiya Samruddhi Investment & Consulting Services (BASIX) - Narayana Hrudayalaya Institute of Medical Sciences - Technology Informatics Design Endeavour (TIDE)

Text Books:

- **RyszardPraszkiar&Andrzej Nowak**, *Social Entrepreneurship: Theory and Practice*, CAMBRIDGE UNIVERSITY PRESS 2012.
- **Singh Archana, EdakkandiMeethalReji**, *Social Entrepreneurship and Sustainable Development*,Routledge India 2020.
- **Jill Kickul and Thomas S.Lyons**,*Understanding social entrepreneurship, the relentless pursuit of mission in an ever changing world*, Routledge India 2012

Reference Books:

- **Robert A. Philips Margret BonefielRitesh Sharma**, *Social entrepreneurship, the next big business opportunity*, Global Vision Publishing House, New Delhi, 2011.
- **Martin, roger and Osberg, sally**,*Social Entrepreneurship: the case for definition*, Stanford social innovation review, 2008
- **Portales, Luis**, *Social Innovation and Social Entrepreneurship*, Palgrave Macmillan, 2019
- **Elliot, Jennifer A**,*An Introduction to Sustainable Development*, Oxon, Routledge 2013

Note:Latest Edition of Text Books may be used.



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Subject Elective - I: Renewable Energy and Energy Harvesting

Semester– V

Hours/week: 3

Course Code: P545C

Credits: 2

Course Objectives:

1. To make the students to understand the importance of fossil fuels, conventional energy resources.
2. To provide a complete idea of basic components of a typical solar collectors and its applications in the solar energy absorption equipment's.
3. To make the students to analyze the dissimilarity between Horizontal axis and vertical axis WECS.
4. To enable the students to comprehend the concept behind various energy sources including biomass, tidal energy and hydrogen energy.
5. To give a basic knowledge about various methods of energy harnessing, storage systems and distribution.

Learning Outcomes

Sl. No.	Course outcomes	Knowledge level
	On successful completion of the course, the students will be able to	
CO1	Explain the basic ideas on commercial and non-conventional energy resources and illustrate their availability.	K2, K4, K3
CO2	Explain the construction and designing of solar collectors and its implementation in the solar energy equipments.	K2, K4, K6
CO3	Demonstrate the variance in the operation of vertical axis and horizontal axis WECS and its installation towards power production.	K3, K6, K5
CO4	Infer the knowledge on various energy sources including ocean, tidal and biomass conversion technologies.	K1, K2, K4
CO5	Realize the need of energy harvesting and describe the methods of storage systems to achieve the sustainability in the energy sector.	K1, K2, K5

Mapping of CO with PO and PSO

CO	Programme Outcome (PO)							Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	2	2	1	1	3	2	3	2	1	2.0
CO2	2	2	3	2	3	2	2	3	2	2	3	2	2.3
CO3	3	2	2	2	2	2	3	2	3	2	2	2	2.2

CO4	2	3	3	2	3	2	2	2	2	2	3	2	2.4
CO5	3	2	2	3	2	2	2	2	3	2	2	2	2.2
Mean Overall Score												2.2	
Results												High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	15	15	30
Understand	15	15	40
Apply	5	5	10
Analyze	5	5	10
Evaluate	5	5	5
Create	5	5	5

Unit-I: Conventional and Alternate Sources of energy

Conventional energy sources – Fossil fuels – types and its limitations – Nuclear Energy – Advantages and disadvantages – working of thermal power plant, hydropower plant and nuclear power plant – Need of alternative energy – Non conventional energy sources – Types – Present scenario in India and Worldwide

Unit-II: Solar energy and its applications

Significance of Solar energy – solar constant – solar energy collector – Types – Liquid Flat plate collector and concentrating collector – storage of solar energy – applications of solar energy – solar water heater – solar pump – solar cell-Solar panel(concept) .

Unit-III: Wind Energy and its applications

Wind energy - Wind mill – Power from the wind – site selection for the installation – Principle and operation of WECS – Types – advantages and disadvantages – Energy storage – Applications of wind energy.

Unit-IV: Other Energy Sources

Biomass – Types – conversion technologies – wet process – photosynthesis – Biogas – Biogas plant – Types – KVIC – Biogas from plant wastes – Geothermal Resources – Energy from the ocean –OTEC(open and closed cycle) –tidal energy–basic principles – hydrogen energy – production and storage

Unit-V: Energy storage and Distribution

Energy storage systems – Mechanical – electrical – chemical – electromagnetic – thermal –biological – Carbon captured technologies -Electric Energy Transfer and Control – energy loss during transfer – methods to minimize the losses- power consumption – Environmental issues –sustainability – energy costing

Books for study

1. S. P. Sukhatme, Solar Energy, Principles of thermal collection and storage, TataMc.GrawHills, New York, 1996.
2. G. D. Rai, Non conventional sources of Energy, Khanna publishers, New Delhi, 1996.
3. Kothari, Renewable energy sources and Emerging technologies, Prentice Hall India Learning Private Limited; 2 edition, 2011.
4. Dr.Niranjan Sahu “ A handbook of Renewable energy and energy harvesting” ,KAAV Publications, 2017

Books for reference

1. D. Yogi Gowswami, Principles of solar engineering, 3rd edition,CRC Press, 2015.

2. John Twidell and Tony weir, Renewable energy resources, 2005,2 edition, Routledge.
3. Frank Kreith, D. Yogi Gowswami Energy conversion, CRC Press, 2007.
4. G.N.Tiwari,M. K. Ghoshal, Renewable energy sources: Basic Principles and Applications, Alpha Science International,2005
5. D. Yogi Gowswami, Energy efficiency and renewable energy handbook, edition,CRC Press, 2015.
6. [Dr. R. S. Khadayate](#), [Dr. K. G. Kolhe](#), [Dr. R. G. Bavane](#), “Renewable energy and Energy Harvesting” ,1st edition ,Prashanth Publications,2019.

Websites

www.solarpowerworldonline.com

en.wikipedia.org/wiki/Fuel

www.conserve-energy-future.com/alternativeenergysources.php

www.altenergy.org/

www.nuclearpower.net

www.renewableenergyworld.com/wind-power/tech.html

https://energypedia.info/wiki/Wind_Energy_-_Introduction

www.otecnews.org

www.geothermal.org

www.wgbn.wisc.edu > Conversion

www.build-a-biogas-plant.com

<https://energystorage.org/why-energy-storage/technologies/hydrogen-energy-storage/>

www.energyharvesting.net/

www.utilitydive.com/

https://en.wikipedia.org/wiki/Electric_power_transmission

<https://www.frontiersin.org/articles/10.3389/fmars.2019.00029/full>

<https://energystorage.org/why-energy-storage/applications/distribution-systems/>

Course designed by:

Verified by HoD:

Name:

Name:

Signature:

Signature:

Checked by CDC:

Approved by CoE:

Name:

Name:

Signature:

Signature:

Subject Elective II: Medical Physics

Semester: V

Hours/week: 3

Course Code: P546C

Credits: 2

Objectives:

1. To provide a knowledge on the physics principles involved in the pressure system, optical system, dynamics of human body and acoustics of human body.
2. To understand radiation exposure and its measurement and the working mechanism of different radiation detectors.
3. To learn the principles and instrumentation involved in various diagnostic systems.
4. To enable the students to understand the principle, instrumentation and working of biological imaging systems.
5. To create awareness on radiation hazards and protection against radiation hazards.

Learning outcomes:

Sl. No.	Course outcomes	Knowledge level
	On successful completion of the course, the students will be able to	
CO1	Explain and differentiate the various physics principles involved in the dynamics of human body and in the pressure system, optical system, and acoustics of human body.	K2
CO2	understand and distinguish the various units used in radiation exposure measurement and describe the working mechanism of different radiation detectors.	K2, K1
CO3	Demonstrate an understanding of working principle and instrumentation of various diagnostic systems.	K3
CO4	understand the principle, instrumentation and working of biological imaging systems and evaluate their merits and demerits.	K2, K5
CO5	Describe various radiation hazards and design equipment for protection against radiation hazards.	K1, K6

Mapping of CO with PO and PSO

CO	Programme Outcome (PO)							Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	3	2	3	2	3	2	3	2	3	2.4
CO2	3	3	3	2	2	2	2	3	3	3	2	2	2.5
CO3	3	2	2	3	2	3	2	2	3	3	2	2	2.4
CO4	3	3	2	3	2	2	2	2	3	3	2	2	2.4
CO5	2	3	3	2	2	3	2	3	3	3	2	2	2.5
Mean Overall Score												2.5	
Results												High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	15	15	30
Understand	15	15	40
Apply	5	5	10
Analyze	5	5	10
Evaluate	5	5	5
Create	5	5	5

Unit – II: Radiation Physics and Detectors

Radiation Exposure – Absorbed dose – Units: rad, rontgen – REM – GRAY – KERMA- CEMA – stopping power – relative biological effectiveness – effective dose - photon fluence and energy fluence.

Detectors – types of detectors –Thimble chamber – condenser chambers – GM counter – Scintillation counter

Unit – V: Radiation hazards and Protection

Radiation effects – radiation dose from natural radioactivity in the environment and manmade sources – effects of time and distance – radiation accidents emergencies in the use of radiation sources in medicine – biological effects of radiation (somatic, genetic stochastic and deterministic effect).

Radiation protection – shielding materials – permissible level of radiation – chemical protection – disposal of radioactive wastes safety rules and facilities – Dosimeter: TLD film badge, pocket dosimeter monitors – Radiation limits – Steps to reduce radiation to Patient, Staff and Public.

Books for study

1. J. P. Woodcock, Ultrasonic, Medical Physics Handbook series 1, Adam Hilger, Bristol, 2002
2. J.R. Cameron and J.G. Skofronick, Medical Physics, Wiley, 1978.

Books for reference

1. K. Thayalan Jayapee Brothers, Basic Radiological Physics Medical Publishing Pvt. Ltd., New Delhi, 2003.
2. Curry, Dowdey, Murry, Christensen's Physics of Diagnostic Radiology, Lippincot Williams and Wilkins, 1990.
3. F M Khan – Williams and Wilkins, Physics of Radiation Therapy, Third edition, 2003.
4. Irving P. Herman, Physics of the human body, Springer, 2007.
5. Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins The essential physics of Medical Imaging, Second Edition, 2002.
6. R.S. Livingstone, Handbook of Physics in Diagnostic Imaging, B.I. Publication Pvt Ltd.

Website for references:

https://www.youtube.com/watch?v=T1WwHh4b__M

<https://en.wikipedia.org/wiki/X-ray>

<https://www.studyandscore.com/studymaterial-detail/geiger-muller-counter-construction-principle-working-plateau-graph-and-applications>

<https://www.youtube.com/watch?v=Sr1BdM89RnA>

https://en.wikipedia.org/wiki/Magnetic_resonance_imaging

<https://www.youtube.com/watch?v=Q9-X4uV8ymk>

<https://www.adacap.com/nuclear-medicine/>

<http://jnm.snmjournals.org/content/57/1/163.full>

https://www.youtube.com/watch?v=gXR5Wdmeu_s

<https://www.healthline.com/health/endoscopy>

Course designed by:

Verified by HoD:

Name:

Name:

Signature:

Signature:

Checked by CDC:

Approved by CoE:

Name:

Name:

Signature:

Signature:

Self Study: **Laser Physics** and Fiber Optics

Semester: V

Hours/week: 2

Course Code:

Credits: 1

Objectives:

- To introduce the students to the basic principles of LASER.
- To provide a knowledge on various types of LASERS.
- To enhance the knowledge of different applications of LASER in Material Processing and Electronics Industry.
- To familiarize the applications of **LASERS in Nuclear Energy and medicine.**
- To provide an opportunity for the students to learn about Optical fibres and Optical fibre communication system.

Learning Outcomes:

Sl. No.	Course outcomes	Knowledge level
	On successful completion of the course, the students will be able to	
CO1	Explain the basic principle of Laser emission.	K2
CO2	Examine the working principle and design considerations of various lasers.	K3
CO3	Outline the applications of laser in industries.	K1
CO4	Gain knowledge on applications of Lasers in fields such as Nuclear Energy, Medicine and Surgery.	K1, K2
CO5	Comprehend the significance of optical fibre communication system.	K2

Mapping of CO with PO and PSO

CO	Programme Outcome (PO)							Programme Specific Outcome (PSO)					Mean score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	2	1	1	2	3	2	3	2	1	2.1
CO2	3	3	2	3	1	1	3	3	2	2	3	1	2.3
CO3	3	3	3	2	1	2	1	3	2	3	2	1	2.2
CO4	3	3	2	2	3	2	1	3	3	2	1	2	2.3
CO5	3	3	2	2	3	1	2	3	3	2	1	2	2.3
Mean Overall Score												2.2	
Results												High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	15	15	30
Understand	15	15	40
Apply	5	5	10
Analyze	5	5	10
Evaluate	5	5	5
Create	5	5	5

Unit III: LASER Applications-1:

LASERS in Material Processing: The surface treatments-Deoxidising De-painting LASER cleaning-Advantages of LASER cleaning – Drilling – Cutting - LASER micro-jet cutting-Different methods of cutting (Vapourization cutting - Melt and blow or Fusion cutting-Reactive cutting)-Advantages and disadvantages of LASER cutting-Welding-Heat treatment-**LASERS in Electronics Industry:** Scribing-Soldering-Trimming-Photolithography.

Unit IV: LASER Applications-2:

LASERS in Nuclear Energy: Isotope separation-Nuclear Fusion-Nuclear Fission-**Laser in Medicine and Surgery:** Eye LASER surgery-Photocoagulations-LASER Angioplasty-LASER endoscopy-LASER therapy-**LASERS in Defense:** LASER based military weapons(Laser gun-Anti Aircraft LASER etc)-LASER target Designator-**Measurement of Distance:** LIDAR(Light Detection and Ranging)-**Holography:**Principle-method-Advantages and Applications.

Books for study

1. Dr. M. N. Avadhanulu, Dr. P. S. Hemme, An Introduction to LASERS, Theory and Applications, 2nd Revised Edition, S. Chand Publishing, New Delhi, 2013.
2. William T Silfvast, Laser Fundamentals, Cambridge Univ Press, 2012.
3. R P Khare, Fiber Optics and Optoelectronics, Oxford 2012.
4. Sabir Kumar Sarkar, Optical fibres and Fibre Optic Communication , 4th Revised Edition, S. chand publishing, 2003.

Web sites:

<https://www.britannica.com/technology/laser/Fundamental-principles>
<https://www.physics-and-radio-electronics.com/physics/laser/heliumneonlaser.html>
https://www.youtube.com/watch?v=X5_BP0odPTg
<https://www.youtube.com/watch?v=RyY4PEpV2RQ>
<https://nptel.ac.in/content/storage2/courses/117101054/downloads/lect7.pdf>
<https://www.physics-and-radio-electronics.com/physics/laser/applicationsoflasers.html>
https://en.wikipedia.org/wiki/List_of_laser_applications
https://www.iitk.ac.in/dord/isro/Publications/DGoswami/marked_Chapter_07.pdf
<https://www.youtube.com/watch?v=jZOg39v73c4>
https://www.youtube.com/watch?v=Zeo3UOk7_vA
<https://www.elprocus.com/basic-elements-of-fiber-optic-communication-system-and-its-working/>
https://www.tutorialspoint.com/principles_of_communication/principles_of_optical_fiber_communications.htm

Course designed by:

Verified by HoD:

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Checked by CDC:

Approved by CoE:

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Nuclear and Particle Physics

Semester– VI

Hours/week: 5

Course Code: P638

Credits: 5

Objectives

- To introduce to the basic properties of nucleus and different nuclear models.
- To study about different types of radiation detectors, radioactivity and particle accelerators.
- To understand the different types of nuclear reactions and radioactivity.
- To learn about fission, fusion and different types of nuclear reactors.
- To provide an overview of elementary particles and their interactions.

Learning outcomes

Sl. No.	Course outcomes	Knowledge level
	On successful completion of the course, the students will be able to	
CO1	explain the properties of nucleus, different nuclear models and their predictions.	K2
CO2	different types of radiation detectors and particle accelerators.	K2, K1
CO3	demonstrate an understanding of the different types of nuclear reactions and radioactivity.	K3
CO4	Distinguish between nuclear fission and fusion, estimate the energy released in Nuclear reactions and compare different types of nuclear reactors.	K4, K5
CO5	Acquire a knowledge of elementary particles and their interactions.	K1

Mapping of CO with PO and PSO

CO	Programme Outcome (PO)							Programme Specific Outcome (PSO)					Mean score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	2	2	2	3	2	2	2	2	2.3
CO2	3	2	2	3	2	2	2	3	2	2	2	2	2.3
CO3	3	2	2	2	3	2	2	2	2	2	2	2	2.2
CO4	3	3	2	2	2	2	2	3	3	2	3	2	2.4
CO5	3	2	2	2	2	2	2	2	2	2	2	2	2.1
Mean Overall Score												2.3	
Results												High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	15	15	30
Understand	15	15	40
Apply	5	5	10
Analyze	5	5	10
Evaluate	5	5	5
Create	5	5	5

Unit – II: Particle Detectors, Radioactivity and Accelerators

Particle detectors – ionization chamber – proportional counter – GM counter – scintillation counter – nuclear emulsions – radiation units – mean lethal dose and permissible radiation dose – personal dosimeter and survey dosimeter – chemical –Thermo luminescent dosimeter(TLD) – biological effects of radiation – protection from radiation hazards – radioactive series - Displacement law – radioactive dating – radioactivity of light elements

Particle accelerators – cyclotron – theory – limitations – synchrotron —betatron.

Unit – III: Radioactivity and Nuclear Reactions

Properties of alpha, beta and gamma rays – determination of e/m and charge of alpha particles –range of alpha particles – experimental measurement of range – Geiger-Nuttal law – disintegration energy – Gamow's theory of alpha decay-beta ray spectra – origin of line and continuous spectrum

Nuclear reactions – types of reactions – conservation laws – Q-value – nuclear transmutations – by alpha particles, protons, deuterons and neutrons – scattering cross section.

Unit – IV: Nuclear Energy and Nuclear Reactors

Nuclear fission – energy released in fission – chain reaction - fissile and fertile materials –deformation of liquid drop – Bohr Wheeler's theory of nuclear fission – four factor formula – the critical size— nuclear fusion and thermonuclear reactions – sources of stellar energy – controlled thermonuclear reactions – Advantages and disadvantages of nuclear energy.

Nuclear reactors:– pressurized water reactor – fast breeder reactor – power reactors –applications of nuclear reactor

Books for study

1. D. C. Tayal, Nuclear Physics, Mumbai, Himalaya Publishing house,2016
2. R. Murugesan, Modern Physics, 18th Edition New Delhi, S.Chand&Co.Ltd, 2019.

Books for reference

1. V. Devanathan,Nuclear and particle physics, 2nd Edison, New Delhi, Alpha Science International publishers, 2011.
2. S. N. Ghoshal, Introduction to Nuclear physics, S.Chand&Co.Ltd, New Delhi, 2019.
3. Suresh Chandra, Mohit K. Sharma, Nuclear and Particle Physics, Alpha Science International publishers, 2012.
4. N. Subrahmanyam, Brijlal, Atomic and nuclear physics, 2nd Edison, New Delhi, S. Chand & Co.Ltd, 2008.
5. R. R. Roy, B.P. Nigam, Nuclear physics, New Delhi, New age International (P)Ltd Publishers, 2005.

Websites

https://www.hep.phy.cam.ac.uk/~chpotter/particleandnuclearphysics/Lecture_13_BasicNuclearProperties.pdf

<https://byjus.com/physics/nuclear-reactor-based-on-nuclear-fission/>

<https://www.youtube.com/watch?v=3bwcXPmF2VA>

<https://www.energy.gov/ne/articles/nuclear-101-how-does-nuclear-reactor-work>

<https://www.youtube.com/watch?v=IMRFDwnLM54>

<http://www.sfu.ca/~mxchen/phys1021003/P102LN34.pdf>

<https://www.nust.na/sites/default/files/documents/Chapter%2012%20E2%80%93Radioactivity.pdf>

<http://www.patnasciencecollege.org/econtent/BScPhys66.pdf>

Course designed by:

Verified by HoD:

Name:

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Checked by CDC:

Approved by CoE:

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Allied Physics for Chemistry –II

Semester: 4

Hours/ Week: 4

Course code: AP409A

Credit: 3

Objectives

- To study the basic ideas of electricity and magnetism
- To study vector atom model and to determine the methods of critical potential
- To study the structure of the alkali spectral lines
- To study the basics of nuclear reactions, process of radioactivity and its applications
- To understand the concepts of wave mechanics and dualistic nature of light
- To study the different methods of preparing thin films, nanomaterials and their applications

Learning Outcomes

Sl. No.	Course outcomes	Knowledge level
	On successful completion of the course, the students will be able to	
CO1	Describe the growth and decay of current in DC circuits, design experiments to calibrate ammeter and voltmeter using potentiometer and distinguish dia, para, and ferromagnetic materials.	K2, K6, K4
CO2	Explain the various quantum numbers associated with the vector atom model.	K2
CO3	Illustrate a knowledge on the basics of nuclear reactions, radioactivity and classification of elementary particles and estimate the amount of energy released in nuclear reactions.	K3, K5
CO4	State and explain the concepts of matter waves, Heisenberg's uncertainty principle and laws of photo electric effect.	K1, K2
CO5	Describe various methods of thin films and Nanomaterials preparation and state the applications of nanomaterials.	K2, K1

Mapping of CO with PO and PSO

CO	Programme Outcome (PO)							Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	3	2	3	3	2	3	2	2	2.6
CO2	3	3	3	2	2	3	2	3	2	2	3	1	2.4
CO3	2	2	2	3	2	3	2	2	2	3	2	3	2.3
CO4	3	3	3	2	3	2	3	2	2	2	3	2	2.5
CO5	2	3	2	2	3	3	1	3	2	3	2	3	2.4
Mean Overall Score												2.5	
Results												High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)	Term End Exam (100)
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	I CA (50)	II CA (50)	Marks Allotment
Remember	15	15	30
Understand	15	15	40
Apply	5	5	10
Analyze	5	5	10
Evaluate	5	5	5
Create	5	5	5

Unit – III: Nuclear Physics

Nuclear Reactions and Radioactivity: Nuclear reactions – types of reactions – conservation laws – Q-value of a nuclear reaction – Neutron – discovery – detection – properties of neutron – artificial transmutation – Rutherford’s experiment – artificial radioactivity – radioisotopes – applications.

Nuclear Energy and Elementary particles: Nuclear fission – energy released in fission – chain reaction – nuclear fusion and particle accelerators – cyclotron and betatron - elementary particles – classification of elementary particles.

Books for study

1. R. Murugesan, [Kiruthiga Sivaprasath](#), Modern Physics, 18th Edition, S. Chand & Co. Ltd, New Delhi, 2019.
2. N. Subrahmanyam and Brij Lal, Atomic and Nuclear Physics, S Chand & Co., 2007.
3. R. Murugesan, Electricity and Magnetism, 10th Edition, S.Chand & Co. Ltd, New Delhi, 2017.
4. A. K. Bandyopadhyay, Nano Materials, New Age International Publishers, New Delhi, 2009.
5. S. Shanmugam, Nanotechnology, MJP Publishers; 1st edition (28 April 2019), Chennai, 2019.

Books for reference

1. N. Subrahmanyam and Brij Lal, Atomic Physics, S. Chand & Co. Ltd., New Delhi, 2013.
2. S.N. Ghoshal, Atomic and Nuclear Physics, S.Chand & Co. Ltd, New Delhi, 2004.
3. R.B. Gupta, Material Science and Processes, Satya Prakashan, New Delhi, 2002.
4. L.I. Maissel and R. Glang, Handbook of Thin film Technology, McGraw–Hill, New York, 2000.
5. A. Goswami, Thin Film Fundamentals, New Age International Pvt. Ltd, New Delhi, 2007.
6. V. Raghavan, Materials science and Engineering, Prentice–Hall of India Pvt. Ltd., New Delhi, 2009.

Websites

<http://www.ncert.nic.in/ncerts/l/kech102.pdf>

<http://www.dartmouth.edu/~physics/labs/writeups/franck.hertz.pdf>

http://physics.doane.edu/hpp/Resources/Fuller3/pdf/F3Chapter_30.pdf

<http://ncert.nic.in/ncerts/l/leph203.pdf>

<http://www.iitg.ernet.in/physics/fac/charu/courses/ph405/uncertainty.pdf>

http://shodhganga.inflibnet.ac.in/bitstream/10603/4025/8/08_chapter%202.pdf

http://www.sc.mahidol.ac.th/scpy/courses/scpy663/lecture3_evaporation.pdf

nccr.iitm.ac.in/2011.pdf

http://www.brainkart.com/article/Magnetism-and-Electromagnetism_39869/

http://ocw.nctu.edu.tw/course/physics/solidphysics_lecturenotes/chapter11.pdf

<https://www.freebookcentre.net/physics-books-download/Atomic-and-Molecular-Physics-NPTEL.html>

<http://ducc.du.ac.in/web4/ever-shrinking-mex/43m9vc1.php?3c6e0b=langevin%27s-theory-of-dia-and-paramagnetism>

<https://npTEL.ac.in/content/storage2/courses/113106065/Week%208/Lesson19.pdf>

https://www.phys.sinica.edu.tw/TIGP-NANO/Course/2020_Spring/notes/08_chapter_2_20200409.pdf

https://www.researchgate.net/publication/259118068_Chapter_-_

[_INTRODUCTION_TO_NANOMATERIALS](#)

http://www.sathyabamauniversity.ac.in/uploads/notes/note_1437661719.pdf

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1.3.1. B.Sc. Chemistry – Environment and Sustainability

B. Sc Chemistry - Scheme of papers (CBCS) - From 2021 – 22 onwards

Year / Semester	Part	Subject	Title of the Paper	Hrs / Week	Credits	Exam hours	Max Marks		
							CIA	Sem	Total
I Year / I Semester	I	Tamil	Tamil – I	5	3	3	50	50	100
	II	English	English – I	5	3	3	50	50	100
	II		Communicative English		1				
	III	Core	Analytical Chemistry - I	4	4	3	50	50	100
	III	Core	Organic Chemistry – I	3	3	3	50	50	100
	III	Core Practical	Volumetric Analysis	3	3				
	III	Allied	Allied Mathematics - I	6	4	3	50	50	100
	IV		FC	2	1				
I Year / II Semester	IV		Religion & Ethics – I	2	1	3	50	50	100
	I	Tamil	Tamil – II	5	3	3	50	50	100
	II	English	English – II	5	3	3	50	50	100
	II		Communicative English		1				
	III	Core	Inorganic Chemistry - I	3	3	3	50	50	100
	III	Core	Physical Chemistry - I	4	4	3	50	50	100
	III	Core Practical	Volumetric Analysis	3	3	3	50	50	100
	III	Allied	Allied mathematics - II	6	4	3	50	50	100
II Year / III Semester	IV		FC	2	1	3	50	50	100
	IV		Religion & Ethics – II	2	1	3	50	50	100
	I	Tamil	Tamil – III	5	3	3	50	50	100
	II	English	General English – III	5	3	3	50	50	100
	III	Core	Organic Chemistry - II	3	3	3	50	50	100
	III	Core	Inorganic Chemistry – II	4	4	3	50	50	100
	III	Core Practical	Qualitative Inorganic Analysis	3	3				
	III	Allied	Allied Physics – I	6	4	3	50	50	100
	IV		FC	2	1				
	IV		Human Rights	2	1	3	50	50	100
II Year / IV Semester	V		DEEDS						
	V		SHELTERS						
			Certificate course – I		2*				
	I	Tamil	Tamil – IV	5	3	3	50	50	100
	II	English	English – IV	5	3	3	50	50	100
	III	Core	Organic Chemistry - III	3	3	3	50	50	100
II Year / IV Semester	III	Core	Physical Chemistry - II	4	4	3	50	50	100
	III	Core Practical	Qualitative Analysis	3	3	4.5	50	50	100
III	Allied	Allied Physics – II	6	4	3	50	50	100	

	IV		FC	2	1		50	50	100
	IV		Environmental Studies	2	1	3	50	50	100
	V		DEEDS		2				
	V		SHELTERS		2				

III Year / V Semester	III	Core	Organic Chemistry – IV	4	4	3	50	50	100
	III	Core	Inorganic Chemistry – III	4	4	3	50	50	100
	III	Core	Physical Chemistry – III	4	4	3	50	50	100
	III	Core	Analytical Chemistry – II	4	4	3	50	50	100
	III	Main Elective	Elective – I	3	2	3	50	50	100
	III	Main Elective	Elective – II	3	2	3	50	50	100
		SSP	Chemistry for Competitive Exam – I		1*				
	III	Core Practical	Gravimetric & Organic Analysis	3	3		50	50	100
	III	Core Practical	Physical Chemistry Practicals	3	3		50	50	100
		NME	Chemistry of Drugs and Disease	2	1		50	50	100
			Certificate Course - II		2*				
III Year / VI Semester	III	Core	Organic Chemistry – V	4	4	3	50	50	100
	III	Core	Inorganic Chemistry – IV	4	4	3	50	50	100
	III	Core	Physical Chemistry – IV	4	4	3	50	50	100
	III	Subject Skill (SS-I)	Paper – I	5	4	3	50	50	100
	III	Subject Skill (SS-II)	Paper – II	5	4	3	50	50	100
	IV	NME	Chemistry in Everyday Life	2	1	3	50	50	100
	III	SSP	Chemistry for Competitive Exam – II		1*				
	III	Core Practical	Gravimetric & Organic Analysis	3	3	6	50	50	100
	III	Core Practical	Physical Chemistry Practicals	3	3	3	50	50	100
			Internship/Industrial Visit/ Case study/Project*		2*				

			Total	180	148 +2* +2* +2*				
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*** Extra credits**

Note:

SSP/Project/Certificate course - optional

Abbreviations

FC	Foundation Course
Comm. Eng	Communicative English
ET	Ethics
RE	Religion
DEEDS	Dept. of extension and educational services.
HR	Human Rights
SSP	Self study paper
NME	Non-major Elective

List of Electives

Elective - I

3 Hours

1. Pharmaceutical Chemistry
2. Forensic Chemistry
3. Bio-Inorganic Chemistry

Elective - II

3 Hours

1. Applied Chemistry
2. Protein Chemistry
3. Cheminformatics

Subject Skill Papers

5 Hours

1. Polymer Chemistry
2. Industrial and Environmental Chemistry
3. Green Chemistry
4. Materials Chemistry
5. Water Chemistry and Inorganic Materials of Industrial Importance
6. Chemistry of Drug Design

Certificate Courses

2 Hours

1. Organic Farming
2. Industrial Safety

CH642B	Theory	4	3	1	0
	CH642B	Industrial and Environment Chemistry		100	4

Course Objectives:

- To introduce the students about industrial extraction processes.
- The pollution induced by the industrial development and the care towards the environment is focused.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.No	COURSE OUTCOME	Knowledge level
CO1	Students will Understand about the basics of polymer and the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both.	K1
CO2	Students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field of Polymer Chemistry.	K1, K3
CO3	Students will be able to evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity.	K1
CO4	Students will also able to about the mechanical properties and applications of polymers.	K2, K3
CO5	Understand basic aspects of the solution properties of polymers, interactions and the relationship to chemical structure, including phase behaviour and the measurement of molecular weight.	K4

Course Content

Unit - I: Chemical Technology

15 Hours

- 1.1. Basic principles of distillation, solvent extraction, methods of leaching separation by absorption and adsorption.
- 1.2. An introduction into the scope of different types of equipment needed in chemical technology, including chemical reactors, distillation columns, extruders, pumps, mills,
- 1.3. Scaling up operations in chemical industry. Problems involving the scaling up of the process. Scale up and process development-Scale up and modeling
- 1.4. Introduction to clean technology for speciality chemicals-economic, environment and safety needs. Clean technology route to waste management

Unit - II: Industrial Metallurgy**15 Hours**

- 2.1. General Principles of Metallurgy
- 2.2. Hydrometallurgy, Methods of purification of metals - Al, Pb, Ti, Fe, Cu, Ni, Zn.
- 2.3. Refining of metal - electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.
- 2.4. Ultrapure metals for semiconductor technology and their applications.
- 2.5. Alloys - Composition and its importance.

Unit - III: Eco systems and Air Pollution**15 Hours**

- 3.1. Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.
- 3.2. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particulate size and chemical nature;
- 3.3. Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution.
- 3.4. Pollution by SO₂, CO₂, CO, NO_x, H₂S and other foul smelling gases. Effects of air pollution on living organisms and vegetation.
- 3.5. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal.

Unit - IV: Aquatic Ecosystems and Purification Systems**15 Hours**

- 4.1. Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.
- 4.2. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).
- 4.3. Industrial effluents from the following industries and their treatment: electroplating, textile, tannery.
- 4.4. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange).
- 4.5. Water quality parameters for waste water, industrial water and domestic water.

Unit - V: Energy & Environment**15 Hours**

- 5.1. Classification renewable and non-renewable. Sources of energy: Coal, petrol and natural gas. Uses and its impact on environment.
- 5.2. Nuclear Fusion/Fission. Process, its uses and its environmental impacts to aquatic life.
- 5.3. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.
- 5.4. Clean energy: Solar energy, Wind Energy, Hydrogen, geothermal, Tidal and Hydraulic energy, etc.
- 5.5. Fuel cells, bio mass, biogas preparation and its environmental impacts

Books for Reference

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK. 1990.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi, 2015
3. K. De, *Environmental Chemistry*, New Age International Pvt., Ltd, New Delhi, 2006
4. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi, 2007
5. W. Hoyle, *Clean Technology for the Manufacture of Speciality Chemicals*, Royal Society of Chemistry, Manchester, UK, 2001

Mapping of CO with PO and PSO

C O	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								Mean Scores of Cos
	PO 1	PO2	PO 3	PO 4	PO5	PO 6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8	
CO1	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO2	3	3	3	3	2	2	2	3	2	3	3	3	3	2	2	2.6
CO3	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO4	3	3	3	2	2	2	2	2	2	3	2	3	3	2	2	2.4
CO5	3	3	3	2	2	2	2	2	2	3	2	3	3	3	2	2.46
CO6	3	3	3	2	2	2	2	2	2	3	2	3	3	2	2	2.4
Mean Overall Score																2.47
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH642C	Theory	4	3	1	0
	CH642C	Green Chemistry		100	4

Course Objectives

- To understand the environmental concern and shrinking resources
- To learn the environmentally friendly products and procedure.
- To take a natural view of different chemical processes

Course Outcomes:

- On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	Gain knowledge about the environmentally friendly products and procedure.	K1
CO2	Appraising Micro Wave and Ultra sound assist organic synthesis	K1, K3
CO3	Relate and asses the applications of green synthesis.Comparison of heterogeneous and homogenous catalysis and photo catalysis	K1
CO4	Analyse the organic compounds which found in application green synthesis	K2, K3
CO5	Understand the environmental concern and shrinking resources	K4
CO6	Designing next generation agrochemicals from nature, using green reagents and bio catalyst.	K1, K3

Course Content**Unit - I: Introduction to Green Chemistry****15 Hours**

- 1.1 Introduction to Green chemistry- What is Green chemistry- Need for green chemistry
- 1.2 Explanation of the twelve Principles of green chemistry
- 1.3 Planning a green synthesis in a chemical laboratory- percentage atom utilization, evaluating the type of the reaction involved, selection of appropriate solvent, starting materials, use of protecting group, catalyst, microwaves and sonication

- 1.4 Atom economy- synthesis of Ibuprofen. Solvent free reactions- scope, utility of solvent free conditions and controlling solvent free reactions.

Unit - II: Green Synthesis - I

15 hours

- 2.1 Organic synthesis in water as Green solvents-pericyclic reaction, Claisen rearrangement, Wittig-horner reaction, Aldol condensation, pinacol coupling
- 2.2 Oxidation, Reduction, Electrochemical synthesis, Carbon-carbon bond formation in aqueous medium (H₂O)
- 2.3 Organic synthesis in supercritical carbon dioxide(SC- CO₂)- properties, phase diagram, as dry cleaning, solvent for organic reaction, asymmetric catalyst, SC polymerization, free radical bromination, Kolbe schmitt reaction
- 2.4 Hydroformylation, hydrogenation, oxidation, coupling reaction, photochemical reaction and biotransformation in SC- CO₂. Formation of silica nano particles using SC- CO₂.

Unit - III: Green Synthesis - II

15 Hours

- 3.1 Green synthesis – compounds like adipic acid, alcohols, cyclohexane oxime, progesterone, paracetamol and polyaspartates
- 3.2 Using Green catalysts – Phase Transfer catalyst- mechanism, types, advantages and applications. Cobalt carbonyl catalysed carbonylation, esterification by PTC.
- 3.3 Comparison of heterogeneous and homogeneous catalysis, bio catalysis, asymmetric and photo catalysis. Photolysis of benzophenone, olefins, free radicals and Barton reactions
- 3.4 Dye removal- Chemical methods- oxidative processes using Fenton's reagent, NaOCl and Electrochemical process. Physical methods and Biological treatments

Unit - IV: Green Synthesis - III

15 Hours

- 4.1 Microwave assisted organic synthesis- Hydrolysis of benzyl chlorides, benzamide, benzoic acid and N-phenyl benzamide. Oxidation of toluene, Coupling of amines with halides and Heterocyclisation
- 4.2 Ultrasound assisted organic synthesis- Instrumentation, types of sonochemical reactions- organometallic reactions, saponification and alkylation. Sonolysis of Fe(CO)₅.
- 4.3 Organic synthesis using polymer supported catalysts- photosensitizers, metalloporphyrin, super acid catalyst and crown ethers
- 4.4 Organic synthesis using Ionic liquids and solids- Knoevenagel reactions, Michael reactions, Wittig reactions and Grignard reaction

Unit - V: Future of Green Chemistry

15 Hours

- 5.1 Future trends in green chemistry-designing next generation agrochemicals from nature- biopesticides approach, classical, inundative approach and its limitation of biological control.
- 5.2 Source of biorational pesticides- allelopathy and microbes. Botanicals as source of agrochemicals. Isolation and identification of the natural products
- 5.3 Organic synthesis using green reagents- ozone, H₂O₂, dioxiranes, peroxy acids, dimethylcarbonates and polymer supported reagents.
- 5.4 Organic synthesis using biocatalysts- biochemical oxidation, biochemical reduction and enzymes catalysed hydrolytic processes

References

1. V. K. Ahluwalia, A textbook *Green chemistry*, published by N. K. Mehra, Narosa Publishers., 2013
2. Rashmi sanghi & M M Srivastava, *Green chemistry, Environmental friendly alternatives*, Alpha Science International, 2003
3. M. A. Ryan & Tinnesand, *Introduction to Green chemistry*, American chemical society, Washington, 2002.
4. A. S. Matlack, *Introduction to Green Chemistry*, Marcel Dekker, 2001.
5. M. C. Cann & M. E. Connely, *Real world in green chemistry*, ASC, Washington, 2000.
6. P. T. Anastas & J. K. Warners, *Green chemistry- Theory and practical*, Oxford University press, 1998.
7. V.K Ahluwalia, *Green chemistry, Environmentally benign reactions*, 2009

Mapping of CO with PO and PSO

C O	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO2	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO3	3	3	3	3	2	2	2	3	2	3	3	3	3	3	2	2.66
CO4	3	3	3	3	2	2	2	2	2	3	3	3	3	3	2	2.6
CO5	3	3	3	2	2	2	2	2	2	3	3	3	3	3	2	2.53
CO6	3	3	3	2	2	3	2	2	2	3	3	3	3	3	2	2.6
Mean Overall Score																2.58
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH642E	Theory	4	3	1	0
	CH642E	Water Chemistry and Inorganic Materials of Industrial Importance		100	4

Course Objectives

- To learn the principles of Water Chemistry and industrial water treatment process
- To understand the principles and properties of Inorganic materials of Industrial importance.
- To study the significance and its applications of Inorganic materials of Industrial importance.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knowledge level
CO1	Identify the water quality parameters learn to calculate them	K1
CO2	Describe the various processes involved in water treatment and compare them	K1, K3
CO3	Understand the fundamental processes involved in glass manufacture and apply them for practical applications	K1
CO4	Differentiate the types of silicates and ceramics and classify them	K2, K3
CO5	Explain and analyse the forms of cement and fertilizers available and formulate their uses	K4
CO6	Understand the various types of coatings available and learn to apply them	K1, K3

Course Content

Unit - I: Water Chemistry-I

15 Hours

- 1.1 Introduction- Origins and scope of water chemistry- Physico-chemical Characteristics of Natural Waters- water quality- Organic load- Chemical parameters governing water quality-
- 1.2 Classification of water quality- Examples of surface water quality in India Waters of Hydration- Hydrogen Bonding-Free and clustered water.
- 1.3 Common concentration units used in water analysis- chemical concentration units- Interconversion among common and chemical concentration units- Alkalinity and Hardness
- 1.4 Properties of Water at High Temperatures and Pressures- Thermo physical and thermochemical- Properties of water below and above 100°C- Effects of temperature on the ion product of water.
- 1.5 Material Compatibility and Corrosion- Corrosion in aqueous systems- Deposit formation vs. Role of zeta potential- Role of alkalinity in steam-water circuits- De-oxygenation

Unit -II: Water Chemistry-II

15 Hours

- 2.1 Treatment of Natural Waters for Industrial Cooling- Bio fouling in natural waters- Operational practice of chlorination
- 2.2 Materials in a cooling water circuit Ferrous sulphate injection- Cooling water treatment
- 2.3 Demineralization by Ion Exchange- Ion exchange resins-Ion exchange process- Properties of ion exchange resins
- 2.4 Demineralization of natural waters- Quality of DM water

- 2.5 Water side corrosion and deposition problems- Chemical treatment of water for industrial and power plant boilers

Unit - III: Silicate and Ceramics

15 Hours

- 3.1 *Glass*: Glassy state and its properties, classification (silicate and non-silicate glasses).
 3.2 Manufacture and processing of glass.
 3.3 Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.
 3.4 *Ceramics*: Important clays and feldspar, ceramic, their types and manufacture.
 3.5 High technology ceramics and their applications, superconducting and semiconducting oxides. Composites: fullerenes, carbon nanotubes and carbon fibre.

Unit - IV Cements and Fertilizers

15 Hours

- 4.1 Cements: Classification of cement, ingredients and their role.
 4.2 Manufacture of cement and the setting process, quick setting cements.
 4.3 *Fertilizers*: Ammonia Synthesis: Haber's process and Contact Process: Sulphuric acid Nitric acids.
 4.4 Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates;
 4.5 Manufacture of the following fertilizers: polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Unit - V: Surface Coatings and Batteries

15 Hours

- 5.1 *Surface Coatings*: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties.
 5.2 Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint),
 5.3 Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings, metal spraying and anodizing.
 5.4 *Batteries*: Primary and secondary batteries, battery components and their role.
 5.5 Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

References

1. K.S. Venkateswarlu, *Water Chemistry-Industrial and Power Station Water Treatment*, New Age International (P) Limited, Publishers, 1996.
2. Patrick Brezonik, William Arnold, *Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems*, Oxford University Press, USA, 2011
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi, 2015.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi, 2007.
4. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi, 2010.
5. P. C. Jain & M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi, 1998.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, 4th edition, Vikas Publications, New Delhi, 2013.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut, 1998.

Mapping of CO with PO and PSO

C O	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								Mean Scores of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	3	2	2	2	2	3	2	3	3	3	2	2	2	2.46
CO2	3	3	3	3	2	2	2	3	2	3	3	3	2	2	2	2.53

CO3	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO4	3	3	3	3	2	2	2	2	2	3	2	3	3	2	2	2.46
CO5	3	3	3	3	2	2	2	2	2	3	2	3	3	2	2	2.46
CO6	3	3	3	3	2	2	2	2	2	3	2	3	3	2	2	2.46
Mean Overall Score															2.48	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Self Study Paper-II

Semester - VI Chemistry for Competitive Examinations – II 1 Credit

SSP	Theory		1	0
VI SEM		Chemistry for Competitive Examinations - I		

Course Objectives

- To motivate the students for self study
- To prepare them for the competitive exams

Course Outcomes:

On successful completion of this Course, students will be able to

S.No.	Course Outcome Statement	Knowledge level
CO1	Define and differentiate oxidation and reduction process in chemical reactions	K1, K2
CO2	To understand the concentration units are used in various real world applications such as pharmacy and environment monitoring.	K3
CO3	Recognize the practical significance of thermodynamics in chemistry, physics, and environmental science.	K3, K4
CO4	To develop problem solving skills to calculate reaction rates, rate constants and other kinetic parameters for various chemical reactions.	K5
CO5	Have a thorough knowledge to calculate the electrical units and their instruments.	K4, K5

Course Content

Unit - I: Oxidation and Reduction

Oxidation number-oxidizing and reducing agents-balancing redox equations

Unit - II: Concentration Units

Normality- acid base reactions-Normality-redox reactions-mole fraction and molality.

Unit - III: Thermodynamics

Heat-internal energy-enthalpy, free energy change and entropy.

Unit - IV: Chemical Kinetics

Rate laws-order-molecularity-half life-collision theory.

Unit - V: Electrochemistry

Electrical units-electrolysis-galvanic cells-Nernst equation.

References

1. R.L. Madan & G.D Tuli, *Physical chemistry*, Questions and answers, S. Chand success guides, 2012.
2. Pearson, *Super course in physical Chemistry*, Dorling Kindersley, 1st edition, 2004.
3. Estelle K Meislich, *3000 problems in organic chemistry vol 1 & 2*, Tata McGraw Hill, 2004.
4. Mc Graw Hill education series, Complete Chemistry, JEE – Main, 2014.

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	2	1	2	3	2	2	3	3	2	3	3	3	1	2	2.3
CO2	3	2	2	2	3	2	2	2	2	2	3	3	2	1	3	2.2
CO3	3	2	1	2	3	2	3	2	3	2	3	2	3	1	3	2.3
CO4	3	2	2	2	3	2	1	2	2	2	2	2	3	2	2	2.1
CO5	3	2	1	3	3	3	2	2	2	2	2	2	3	2	2	2.2
Mean Overall Score																2.2
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
	Theory	30	25	5	0
		Course Name		Max Marks	Credits
		ORGANIC FARMING		100	2

Course Objectives:

- To know the evil effects of Chemical farming
- Need for organic farming
- To know merits of Bio-nutrients
- To learn the process of certification of organic farming

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
CO1	Evaluate the environmental impact of chemical farming on soil, water, and biodiversity	K3
CO2	Assess the health implications of chemical farming, including the effects on human health and nutrition	K4
CO3	Differentiate between organic agriculture and conventional agriculture, highlighting ideological differences	K1 & K2
CO4	Examine various forms of organic management and their historical development	K3
CO5	Formulate organic production plans, considering conversion requirements, diversity in crop production, and pest management	K3
CO6	Evaluate the effectiveness of different bio-nutrients, including organic manures, compost, and biofertilizers, in sustainable farming practices	K4
CO7	Critically assess the significance of organic certification, its processes, and the marketing implications for organic food exports	K5

Course Content:

Unit - I: Chemical Farming: Demerits

6 Hours

Impact on soil - Impact on surface water and ground water- Pesticides in aquatic ecosystem-Pesticide residues in bottled water - Impact of pesticides on biodiversity- Effect on food chain- Destruction of pollinators - Ecological significance-Chemical farming: Damage to health and nutrition-Impact of chemical farming on health-evils of pesticides -Impacts of some of the pesticides on human health- Organic farming increases nutrition while chemical farming robs us of it. **Chemical farming: Damage to the environment**

Unit - II: Organic farming

6 Hours

Meaning of Ideological differences between organic agriculture and conventional agriculture, History of Organic Farming, Principles, Need for Organic Farming in India, Some Other forms of Organic Management Close to Nature and Tradition

Biodynamic Agriculture, Rishi Krishi, Panchgavya Krishi, Natural farming, Basic Principals of Natueco farming, Homa Farming

Unit - III: Organic Production

6 Hours

Organic production requirements, conversion requirements, maintenance of organic management, landscape, crop production: Duration of conversion period, diversity in crop production, fertilization policy, pest, disease and weed management including growth regulators, contamination control, collection of non cultivated material of plant origin.

Unit - IV: Bio-Nutrients

6 Hours

Bio-intensive nutrient management: Principles of microbial degradation, organic manures, Quality and composition of FYM, Improved methods of handling farm yard manure, ways to minimize these losses from FYM during handling, Sheep and Goat manure, , compost, stages of composting, methods of composting, activated compost process, Indore process, Bangalore process, The Coimbatore process. Vermicompost: Types of earthworms in vermicomposting, vermicompost preparation, harvesting of the vermicompost from the pit, precautions, Nutrient composition of vermicompost, advantage of vermicompost, green manure, crop residues

Biofertilisers: Symbiotic Bacteria-free living organisms, Blue-green Algae (BGA), Azotobacter and Azospirillum, Mycorrhiza and Phospho-micro Organisms, Saprophytes

Integrated pest management, Cultural methods, Behavioural methods, Biological methods, Bio-pesticides, Botanicals, Trap cropping, Bird perches.

Unit - V: Organic Farming- Certification

6 Hours

Integrated weed management: Ecological management, Biological management:

Quality considerations-Quality standards, Health Benefits of Organic Food, Organic certification, Purpose of certification, Third party certification process, Participatory certification, Certification & product labeling, ORGANIC LOGO, Manipulation of regulations, Misrepresentation of the term *organic*, Accreditation, Position of Accreditation in India, Marketing and Organic Food Exports from India.

References

1. S.S,Rana. *Teaching Manual: Organic Farming.*, CSK Himachal,Pradesh Krishi Vishvavidyalaya, Palampur (2016)
2. Ilka Gomez and Lisa Thivant, *Food and Agriculture Organization of the United Nation* (FAO)(2015)
3. Paul Kristiansen, *Organic Agriculture*, CSIRO Publishing, 2006.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	3	3	3	3	2	2	3	3	2	2	2	3	2	2.6
2	3	2	3	3	2	3	3	2	3	3	2	3	3	2	2	2.6
3	3	3	3	3	3	3	2	2	3	3	2	2	2	3	3	2.7
4	3	3	3	3	2	2	3	3	3	3	2	3	2	2	2	2.6
5	3	3	3	3	2	2	2	2	3	3	2	3	3	3	3	2.7
6	3	3	3	3	2	3	2	2	3	3	3	3	3	3	2	2.7
Mean Overall Score															2.6	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10



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1.3.1. M.Sc. Chemistry – Environment and Sustainability

SACRED HEART COLLEGE (AUTONOMOUS)

TIRUPATTUR – 635601, TIRUPATTUR DISTRICT

PROPOSED OBE FRAMEWORK

M. SC. CHEMISTRY

2021 - SYLLABUS

Sem	Sub	Title of the paper	Ins Hrs	Cr	CA Mks	Sem Mks	Total	
I	Core	Organic Chemistry – I	4	4	50	50	100	
	Core	Inorganic Chemistry – I	4	4	50	50	100	
	Core	Physical Chemistry – I	5	4	50	50	100	
	Core Practicals		Organic Practicals – I	4	-	-	-	-
			Inorganic Practicals – I	4	-	-	-	-
			Physical Practicals – I	4	-	-	-	-
Elective - I	1. Analytical Chemistry 2. Green Chemistry 3. Pharmaceutical Chemistry	5	5	50	50	100		
II	Core	Organic Chemistry – II	4	4	50	50	100	
	Core	Inorganic Chemistry – II	4	4	50	50	100	
	Core	Physical Chemistry – II	5	4	50	50	100	
	Elective - II	1. Research Methodology 2. Heterocyclic Chemistry 3. Bio-organic Chemistry	5	5	50	50	100	
	SSP	Reagents in Organic Chemistry	0	2*				
	Core Practicals		Organic Practicals – I	4	4	50	50	100
			Inorganic Practicals – I	4	4	50	50	100
		Physical Practicals – I	4	4	50	50	100	
III	Core	Organic Chemistry – III	4	4	50	50	100	
	Core	Inorganic Chemistry – III	4	4	50	50	100	
	Core	Spectroscopy	5	4	50	50	100	
	Elective - III	1. Inorganic photochemistry and materials science 2. Polymer Chemistry 3. Chemoinformatics	5	5	50	50	100	
	Core Practicals	Organic Practicals – II	4	-	-	-	-	

		Inorganic Practicals – II	4	-	-	-	-	
		Physical Practicals – II	4	-	-	-	-	
IV	Core	Organic Chemistry – IV	4	4	50	50	100	
	Core	Inorganic Chemistry - IV	4	4	50	50	100	
	Core	Physical Chemistry – III	5	4	50	50	100	
	Core Practicals		Organic Practicals – II	4	4	50	50	100
			Inorganic Practicals – II	4	4	50	50	100
			Physical Practicals – II	4	4	50	50	100
	HR	Human Rights	2	1	50	50	100	
	Project	Project Work	3	2	20 Viva	80 Thesis	100	
	IDC	Advanced analytical technique/BMT		2*				
	SSP	Chemical Sciences For CSIR-UGC-NET/JRF/ GATE		2*				
		Total	120	90+6*			2200	

Required Credits = 90 (89 + 1–HR)

Additional credits for Chemistry students - 6* Credits

1. Credits from parent department (2+2)

Self-Study Paper (Chemical Science for CSIR/SET) : 2* Credits

Self-Study Paper (Reagents in Organic Chemistry) : 2* Credits

2. Additional credits (Chemistry, Bio-chemistry and Physics department)

Inter Disciplinary Course (IDC) : 2*Credits

Advanced Analytical Techniques / BMT

- **Classes will be taught outside the class hours**
- **Based on the demand the course fee may be fixed**

3. Internship:

Regulations for Inter Disciplinary Course [IDC]

IDC- AAT / Biochemical and Microbial Techniques

Credit : 2*Credits
 Hours : 30 Hours (20+10)
 Semester : II Year [Semester - III & IV]
 Evaluation Pattern : Test-I and Test-II
 Maximum Marks : 50 Marks
 Minimum Marks : 25 Marks

Regulations for Self-Study Paper [SSP]

1. Reagents in organic Chemistry

2. Chemical Science for CSIR / SET

Credit : 2*Credits
 Semester : Semester - II and IV
 Evaluation Pattern : one Test
 Maximum Marks : 100 Marks
 Minimum Marks : 50 Marks

CH717 - Inorganic Chemistry-I

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
CH717	Theory	60	55	5	0
		Course Name		Max Marks	Credits
		INORGANIC CHEMISTRY-I		100	4

Course Objectives:

- To impart the knowledge about the structure of materials and their significance.
- To understand the theories of coordination complexes and their importance.
- To study the basic chemistry of rare earth elements and nano materials

Course Outcomes

At the end of this course, the students will be able to

CO1	Gain knowledge about the structure and bonding of Inorganic compounds like polyacids, Inorganic Polymers, polysulphur – nitrogen and their significance	K1, K2
CO2	Correlate the structure, bonding, stability and applications of metallocarboranes and Metal Clusters	K4
CO3	Relate and assess the applications of organometallic compounds in the field of synthetic chemistry and catalysis	K3, K5
CO4	Analyse the solid materials with defects that can be used in field of electronic industries for designing energy materials.	K5
CO5	Understand the Solid-state Transformation, its thermodynamic, kinetics and nucleation in solid state materials	K2
CO6	Design and synthesis the energy producing nano materials and energy storage nanomaterials to meet the energy crisis in the future	K6

Course Content

Unit - I: Structure and Bonding – I

12 Hours

Polyacids: Isopolyacids and heteropolyacids of vanadium, chromium, molybdenum and Tungsten. Inorganic Polymers: Silicates, structure – properties – correlation and applications – molecular sieves, polysulphur – nitrogen compounds and poly organophosphazenes.

Unit - II: Structure and Bonding – II

12 Hours

Boron hydrides: Polyhedral boranes, hydroboration, carboranes and metallocarboranes Metal Clusters: Chemistry of low molecularity metal clusters (upto) trinuclear metal Clusters: multiple metal-metal bonds.

Unit - III: Solid State Chemistry – I

12 Hours

Introduction-Single and polycrystalline materials-Solid state Reactions-Co-precipitation as precursor to solid state reactions-Other Precursor Methods-Kinetics of solid-state reactions-Perfect and imperfect crystals. Defects in solids: Point defects-Schottky defects-Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation. Non-stoichiometric defects: metal excess and metal deficiency. Spinels-solid state lasers-inorganic phosphors-Ferrite.

Unit - IV: Solid State Chemistry – II

12 Hours

Colourcentres-Vacancies and interstitials in non-stoichiometric crystals. Extended defects –subgrain boundaries and antiphase domains-Solid state transformations-Classification of transformations-Thermal decomposition reactions-Laws governing nucleation-Crystal growth of nuclei-Reaction between two solids-polymorphism-Characterization and properties of polymorphs.

Unit - V: Chemistry of rare earths and nanomaterials

12 Hours

The Chemistry of solid state, lanthanides and actinides, oxidation state spectral, magnetic characteristics, coordination numbers, nuclear and non-nuclear applications.

Nanomaterials: General introduction - Synthesis of nanoparticles of gold and silver - Synthesis of nanoparticle semiconductors (TiO_2 and Fe_2O_3) - Nanowires and nanorods - Self-assembled nanostructures - Self-assembly and bottom-up fabrication – Graphenes, fullerenes and nanotubes - Applications of nanoparticles-application as sensors, biomedical applications, application in optics and electronics.

Text Books

References

1. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, WB Saunders Co., USA, 1977.
2. J.E. Huheey, Harper and Collins, Inorganic Chemistry, NY, IV Edition, 1993.
3. FA Cotton and G.W. Wilkinson, Advanced Inorganic Chemistry, – A comprehensive Text, John Wiley and Sons, 1988.
4. B.E. Dogulas DH McDaniel's and Alexander Concepts and Models of Inorganic Chemistry, Oxford IBH, 1983.
5. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, Univ. Science Books, 1994.
6. W. Kaim and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life (An introduction and Guide), John Wiley & Sons, 1994.
7. WU. Mallik, G.D. Tuli, R.D. Madan, Selected topics in Inorganic Chemistry, S. Chand and Co., New Delhi, 1992.
8. A.R. West, Basic solid-state chemistry, John Wiley NY, 1991.
9. W.E. Addison, Structural principles in Inorganic chemistry, Longman, 1961.
10. D.M. Adams, Inorganic solids, John Wiley Sons, 1974.
11. J.N. Gurtu, Solid State Chemistry, Second Edition, PragatiPrakashan Publishers, 2015.
12. Dieter Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2nd Edition Wiley, 2013.
13. Zhong Cao G, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, London, United Kingdom, 2004

Online Resources

1. <http://eacharya.inflibnet.ac.in/> (Bioinorganic Chemistry-40 lectures)

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)						Programme Outcomes (PO)					Mean Scores of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	
1	3	3	3	3	3	2	3	3	2	3	2	2.7
2	3	3	3	3	3	2	3	3	3	3	2	2.8
3	3	3	3	3	3	3	3	3	3	3	3	3.0
4	3	3	3	3	3	3	3	3	3	3	3	3.0
5	3	3	3	3	2	2	3	3	3	3	2	2.7
6	3	3	3	3	3	3	3	3	3	3	2	2.9
Mean Overall Score												2.9
Result												High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH719B – GREEN CHEMISTRY

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
CH719B	Theory	75	65	10	0
		Course Name		Max Marks	Credits
		GREEN CHEMISTRY		100	4

Objectives:

- To know eco-friendly methods of synthesis.
- Understanding the synthesis of any type of organic compounds with the revolution of Green Chemistry

Course Outcomes

At the end of this course, the students will be able to

CO. No.	Course Outcome Statement	Cognitive Level
CO 1	Understand and compare the eco-friendly methods of synthesis.	K1, K2
CO 2	Appraising the measurement, Prevention and control of life-cycle assessment	K4
CO 3	Relate and assess the Renewable energy as Biomass, Fossil Fuels, solar energy and some other natural chemical resources.	K3, K5
CO 4	Analyse the organic compounds which found in application of green synthesis with the revolution of Green Chemistry.	K5
CO 5	Compare and analyze Green Technology and Alternative Energy Sources such as Microwaves, Electrochemical synthesis	K2
CO 6	Design the next generation agrochemicals and Industrial Case Studies from nature, using green reagents and bio catalyst.	K6

Course Content**Unit - I: Principles & Concept of Green Chemistry 15 Hours**

Introduction –Concept and Principles-development of Green Chemistry- Atom economy reactions – rearrangement reactions, addition reactions- atom uneconomic-sublimation-elimination-Wittig reactions-toxicity measures- Need of Green Chemistry in our day-to-day life.

Unit - II: Measuring and Controlling Environmental Performance 15 Hours

Importance of measurement – lactic acid production-safer Gasoline – introduction to life cycle assessment-four stages of Life Cycle Assessment (LCA) –Carbon foot printing-green process Matrics-eco labels - Integrated Pollution and Prevention and Control (IPPC)-REACH (Registration, Evaluation, Authorization of Chemicals).

Unit - III: Emerging Green Technology and Alternative Energy Sources 15 Hours

Design for Energy Efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry- Microwave heating –Microwave assisted reactions-Sono chemistry and Green Chemistry –Electrochemical Synthesis-Examples of Electrochemical synthesis.

Unit - IV: Renewable Resources 15 Hours

Biomass –Renewable energy – Fossil Fuels-Energy from Biomass-Solar Power- Other forms of renewable energy-Fuel Cells-Alternative Economics-Syngas economy- hydrogen economy-Bio refinery chemicals from fatty acids-Polymer from Renewable Resources –Some other natural chemical resources.

Unit - V: Industrial Case Studies

15 Hours

Methyl Methacrylate (MMA)-Greening of Acetic acid manufacture-Vitamin C-Leather manufacture – Types of Leather –Difference between Hide and Skin-Tanning –Reverse tanning –Vegetable tanning – Chrome Tanning-Fat liquoring –Dyeing –Application-Polyethylene- Ziegler Natta Catalysis-Metallocene Catalysis-Eco friendly Pesticides-Insecticides.

References

1. Mike Lancaster, Green Chemistry and Introductory text, II Edition,2003.
2. P.T.Anastas and J.C Warner,Green Chemistry theory and Practice, Oxford University press, Oxford, 1988..
3. P.Tundo*et. al.*, Green Chemistry, Wiley –Blackwell, London, 2007.
4. V.K. Ahluwalia, Environmental chemistry, Ane Books, India, 2003.
5. T.E Graedel, Streamlined Life cycle Assessment, Prentice Hall, NewJersey, 1998.
6. V.K. Ahluwalia, Methods and Reagents of Green Chemistry: An Introduction to Green Chemistry, 2013.

Online Resource

www.clri.org.

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	3	2	3	3	3	3	2	3	3	3	2.82
CO2	3	3	2	2	3	3	2	3	3	2	3	2.64
CO3	3	3	3	3	3	3	2	3	3	3	3	2.91
CO4	3	3	3	2	3	3	3	2	3	3	3	2.82
CO5	3	3	3	3	3	3	2	3	3	3	3	2.91
CO6	3	3	3	3	3	3	3	3	2	3	3	2.91
Mean Overall Score												2.83
Result												High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH821C – BIO - ORGANIC CHEMISTRY

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
CH821C	Theory	75	65	10	0
		Course Name		Max Marks	Credits
		BIO – ORGANIC CHEMISTRY		100	4

Objectives:

- To enable the student to understand and appreciate the importance of biomolecules.
- To understand the techniques involved in the extraction and methods of determination of structure of natural products.
- To describe the structure and function of nucleic acids
- To learn the synthetic procedure of alkaloids and terpenoids and their applications.
- To synthesis the steroids compounds and interpret their biological role.
- To Illustrate the method of synthesis of flavonoids.

Course Outcomes

At the end of this course, the students will be able to

CO. No.	Course Outcome Statement	Cognitive Level
CO 1	Understand and know the importance of the biomolecules	K1, K2
CO 2	Apply the extraction techniques and elucidate the structure of natural products.	K3, K4
CO 3	Describe the structure and function of DNA and RNA and justify the denaturation of nucleic acid	K2, K5
CO 4	Synthesis a common alkaloid and terpenoids and know their importance	K5
CO 5	Design the synthetic route of steroids and interpret their functions in biological system	K3, K6
CO 6	Describe the general method of synthesis of anthocyanins and flavonoids.	K2

Course Content

Unit - I: Carbohydrates

15 Hours

Configuration and conformations of monosaccharides, anomeric effect, epimerization and mutarotation. Determination of ring size of monosaccharides. Synthesis, industrial and biological importance of glycosides, amino sugars, sucrose and maltose. Industrial and biological importance of cellulose, starch, glycogen, dextran, hemicellulose, pectin, agar-agar, cytosine, crysin. Glycolysis and its reversal; TCA cycle. Relation between glycolysis and respiration.

Unit - II: Proteins and Nucleic Acids

15 Hours

Classification – properties - 3D structure of protein; Determination of C and N-terminal amino acid sequence – denaturation and renaturation of proteins. Separation and purification of proteins – dialysis – gel filtration - electrophoresis. Catabolism of amino acids: transamination, oxidative deamination, decarboxylation and urea cycle. Introduction, structure and synthesis of nucleosides and nucleotides, protecting groups for hydroxy group in sugar, amino group in the base and phosphate functions. Methods

of formation of internucleotide bonds: Structure of RNA and DNA, Crick-Watson model. Solid phase synthesis of oligonucleotides. Role of nucleic acids in the biosynthesis of proteins.

Unit - III: Alkaloids and Terpenoids

15 Hours

General methods of structural elucidation of alkaloids. Structural elucidation of apaverine and cocaine; synthesis and functions of atropine, heptaphylline, morphine. General methods of determination of structure of terpenoids. Structural elucidation of cadinene, vitamin A, abietic acid; synthesis and functions of gibberelic acid, zingiberine and squalene

Unit - IV: Steroids

15 Hours

Conformations of steroids - molecular rearrangements (acid, base catalysed, and photochemical). Synthesis of steroids – ring forming reaction and control of ring junction stereochemistry. **Synthesis and functions of cholesterol, androgens, oestrone, progesterone and cortisone.**

Unit - V: Anthocyanins and flavonoids

15 Hours

General nature and structure of anthocyanins. General methods of synthesizing anthocyanidins. Structural elucidation of cyanidin chloride, pelargolidin chloride, Hirsutidin chloride. Flavones – flavonols – isoflavones. **Biosynthesis of flavonoids.**

References

1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, 2007.
2. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 1, Himalaya Publishing House, Mumbai, 2009.
3. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 2, Himalaya Publishing House, Mumbai, 2009.
4. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 1, Goel Publishing House, Meerut, 1997.
5. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 2, Goel Publishing House, Meerut, 1997.
6. L. Finar, Organic Chemistry Vol-2, 5th ed., Pearson Education Asia, 1975.
7. L. Finar, Organic Chemistry Vol-1, 6th ed., Pearson Education Asia, 2004.
8. Pelletier, Chemistry of alkaloids, Van Nostrand Rein

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	2	3	3	2	3	3	3	2	3	3	2.73
CO2	3	2	3	3	3	3	3	2	3	3	3	2.82
CO3	3	3	3	2	2	3	3	2	3	2	3	2.64
CO4	3	3	3	2	2	3	3	2	3	3	3	2.73
CO5	3	3	3	3	2	3	3	2	3	3	3	2.82
CO6	3	3	3	2	2	3	3	3	2	3	3	2.73
Mean Overall Score												2.74
Result												High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH1017 - Organic Chemistry-IV

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
CH1017	Theory	60	55	5	0
		Course Name		Max Marks	Credits
		ORGANIC CHEMISTRY IV		100	4

Course Objectives

- To know modern synthetic methods and synthetic strategies. This help in planning the synthesis of any types of organic compounds.
- To learn the synthesis and bio-synthesis of heterocyclic products.

Learning Outcomes:

- Any types of organic compounds synthesis were learned by the students, through modern synthetic methods and strategies.
- Synthesis and bio-synthesis of heterocyclic products were also learned by the students

Course Outcomes:

Sl. No.	Course Outcome Statements	Knowledge level
	On successful completion of this Course, students will be able to	
CO1	Define the modern synthetic terminologies/methods and build the synthetic strategies incorporated in retrosynthesis of various types of organic molecules	K1, K6
CO2	Identify suitable protecting reagents for the protection of multifunctional organic molecules and predicting suitable deprotecting reagents after the completion of desired reaction.	K1, K2
CO3	Sketch various heterocyclic compounds structure with numbering and their interaction with various chemical reagents in detail.	K3
CO4	Illustrate the importance of environmentally benign solvents and their role in synthetic organic reactions.	K4
CO5	Validate the structure of various natural organic molecules and confirming their structure through total synthesis	K5
CO6	Build the synthetic route theoretically for a given target molecule in retrosynthetic way with theoretical justification.	K6

Course Content**Unit - I: Retrosynthetic Analysis-I****12 Hours**

Basic guidelines and terminology of retrosynthesis (synthons, FGI, disconnection approach), Important functional group interconversion synthesis of aromatic compounds-, one group C-X disconnections and

two group C-X disconnections, one group C-C disconnections and two group C-C disconnections, important strategies of retrosynthesis.

Unit - II: Retrosynthetic Analysis-II and Protecting Functional Groups **12 Hours**

Amine and alkene synthesis, umpolung carbonyl group reactivity in synthesis, Protection and deprotection of hydroxy, carbonyl, amine and carbon-carbon multiple bonds; chemo- and regioselective protection and deprotection; illustration of protection and deprotection in synthesis.

Unit - III: Chemistry of heterocyclic compounds **12 Hours**

Numbering of heterocyclic compounds, structure, preparation and reactions of heterocyclic compounds (pyrrole, furan, thiophene, 1,2- and 1,3-azoles, triazoles, pyridine, pyryliums, diazines, triazine), Fused heterocycles containing one or more heteroatoms (indoles, benzofurans, benzothiophene, benzenellated azoles, quinolines, isoquinolines, benzopyrones).

Unit - IV: Green chemistry and Natural Products Chemistry **12 Hours**

Green chemistry: Importance and synthetic reactions of green solvents as reaction medium (water, ScCO₂, Polyethylene glycol)- Ionic liquids (alkylation and coupling reactions)-microwave assisted organic synthesis.

Steroids: Sterols and bile acids, estrogens, androgens: **Alkaloids:** Structure, synthesis Reserpine, Morphine. **Terpenoids:** Zingiberene, Squalene. Natural Pigments: structural confirmations of flavones, flavanones, isoflavones, xanthenes, quinones.

Unit - V: Bioorganic Molecules **12 Hours**

Molecular structure and numbering of Purines (Uric acid, Cytosine, Adenine, Guanine) & Pyrimidines (Uracil, thymine & Cytosine). Nucleic acids-Functions of nucleic acids- Structural features of nucleosides and nucleosides- structure and biological implications of DNA and RNA (m-RNA, t-RNA and r-RNA) - replication of DNA - Genetic code and informational theory. Proteins – standard amino acids - peptide synthesis-End group analysis (Sanger's method, Edmon's degradation) - primary, secondary, tertiary structure and quaternary structure of proteins and their determination.

References

1. William Caruthers and Iain coldham, Modern methods of organic synthesis, IV Edition, Cambridge university press, 2004.
2. Michael B Smith, Organic Synthesis, Tata Mc Graw Hill, 1994.
3. Stuart warren, Organic synthesis the disconnection approach, Wiley India edition, 2004.
4. V K Ahluwalia and Renuagarwal Organic synthesis special techniques, second edition, Narosa Publishing House, 2007.
5. J.March, Advanced Organic Chemistry, 4thEdn, Wiley Publications, 1992.
6. Gurdeep R Chatwal, Organic Chemistry of Natural Products, Vol 1 & 2, revised Edn., Himalaya Publications, 2009.
7. O.P Agarwal, Chemistry of Organic Natural Products, Vol 1 & 2, Goel Publications, 28thEdn., 2002.
8. S.P.Bhutani, Chemistry of Biomolecules, Ane Books, 2009.
9. George S. Zweifel, Michael H Nantz, Modern Organic Synthesis – an introduction, W.H.Freeman and Company, 2007.
10. Raj K Bansal, Heterocyclic chemistry, fourth edition, New Age International Publishers, 2005.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)						Programme Outcomes (PO)					Mean Scores of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	
CO1	3	3	3	2	2	2	3	3	2	2	2	2.4545455
CO 2	3	3	2	2	2	2	3	2	2	2	2	2.2727273
CO 3	3	3	3	3	2	3	3	3	3	2	2	2.7272727
CO 4	3	2	3	3	3	3	3	2	3	3	1	2.6363636
CO 5	3	2	3	2	2	3	2	2	3	3	1	2.3636364
CO 6	3	3	3	3	2	2	3	3	3	3	1	2.6363636
Mean Overall Score											2.515152	
Result												

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH1019 – PHYSICAL CHEMISTRY III

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
CH1019	Theory	75	65	10	0
		Course Name		Max Marks	Credits
		PHYSICAL CHEMISTRY III		100	4

Objectives:

- To study the importance and theory of ionic conductance.
- To learn the concepts of electrode - electrolytic interface and structure of the double layer.
- To learn the mechanism of electrode reactions and electron transfer process.
- To illustrate the importance and industrial applications of different types of fuel cells.
- To understand the concepts of various methods of energy calculation in many electron systems.
- To apply the VB, MO and HMO theory to simple many electrons system.

Course Outcomes

At the end of this course, the students will be able to

CO. No.	Course Outcome Statement	Cognitive Level
CO 1	Comprehend the concept of activity coefficient and ionic strength of electrolytes and to evaluate and relate the mean ionic activity coefficient of electrolytes.	K3 & K5
CO 2	Describe the structure of the electrified interface, and define and describe mathematically the capacitance of various model of double layer	K1 & K2
CO 3	Calculate and analyse the electron transport and kinetic overpotential for electrodes at which a one-step and multi-step electron reaction takes place.	K3 & K4
CO 4	Know about the behaviour of ions in solution phase under different conditions and its application towards different energy storage devices	K1 & K3
CO 5	Describe many-electron atoms with the various approximation methods and evaluate the energy and construct wave function of many electron atoms with suitable methods	K2, K5 & K6
CO 6	Describe the chemical bonding quantum mechanically with VB, MO and HMO theory and able to calculate the pi electron energy to simple systems.	K2 & K3

Course Content

Unit - I: Electro Chemistry – I

15 Hours

The nature of electrolytes –ion-ion and ion-solvent interactions. The Debye- Huckel theory of ion -ion interaction. Mean ionic activity and mean ionic activity coefficient - activity coefficient of strong electrolytes - determination of activity coefficient by electrochemical method.

Debye Huckel limiting law derivation and verification - limitation of Debye Huckel limiting law at appreciable concentrations of electrolytes - Debye - Huckel – Onsager equation derivation and validity. Conductivity at high frequency (Debye-Falkenhagen effect) and at high field strength (Wien effect).

Unit - II: Electro Chemistry – II

15 Hours

Electrode - electrolyte interface - adsorption at electrified interface - electrical double layer - electro capillary phenomenon - Lippmann equation - Structure of double layers - Helmholtz - Perrin, Guoy - Chapman and Stern model of electrical double layers.

Mechanism of electrode reactions - polarization and over-potential - the Butler-Volmer equation for one step and multistep electron transfer reactions - significance of electron exchange current density and symmetry factors - transfer coefficient and its significance.

Unit - III: Electro Chemistry – III

15 Hours

Mechanism of the hydrogen and oxygen evolution reactions. Diffusion - Fick's law of diffusion - Effect of ionic association on conductance- Electro-kinetic phenomena – Electro-osmosis. Streaming potential – electrophoresis.

Corrosion and passivation of metals - Pourbaix diagram - Evan's diagram - Modern Batteries – Nickel-metal hydride batteries, lithium secondary batteries. Fuel cells – History – Types of fuel cells – H₂ / O₂ fuel cells – Direct methanol fuel cells– Alkaline fuel cells – phosphoric acid fuel cells - Molten carbonate fuel cells (High temperature fuel cell) – Proton exchange membrane fuel cells (PEM Cells). electrodeposition - principle and applications.

Unit - IV: Applications of Quantum Chemistry – III

15 Hours

Approximation methods - Need for approximation – Perturbation Theory – Time independent Perturbation (First order only) - Application of Perturbation theory to particle in one dimensional box, anharmonic oscillator and helium atom – Variation method – principle – methodology and its applications to hydrogen and helium atoms. Semi - empirical methods - Slater orbital and HFSCF methods.

Unit - V: Applications of Quantum Chemistry – IV

15 Hours

The Born - Oppenheimer approximation – VB and MO theories as applied to hydrogen molecular ion (H₂⁺) and hydrogen molecule – coulomb integral an exchange integral and an overlap integral. Construction of sp, sp² and sp³ hybrid orbitals - Huckel molecular orbital theory – principles and applications to ethylene, butadiene and benzene. Huckel calculation of pi- electron energies.

TEXT BOOKS

1. J.O.M. Bokris and A. K. N. Reddy, Electrochemistry, Vol. 1, 2A and 2B, Plenum, New York, 1977
2. Donald A McQuarrie, Quantum chemistry, Indian Edition, Viva Books Private Limited 2005.

REFERENCES

1. S. Glasstone, Introduction to Electrochemistry, Affiliated East West Press, New Delhi 1960.
2. D.R.Crow, Principles and Applications to Electrochemistry, Chapman and Hall 1991
3. ViswanathanB.,M.AuliceScibioh, Fuel Cells-Principles and Applications, Universities Press, Hyderabad, India, 2006
4. J. Robbins, Ions in Solution - An Introduction of Electrochemistry, Clarendon Press, Oxford, 1972
5. B.K.Sharma, Electrochemistry, Krishna Education publication, 2019.
6. R.K. Prasad, Quantum Chemistry, 1st Edition, New Delhi, Wiley Eastern Ltd, 1992.
7. Anderson J. M. Mathematics of Quantum Chemistry, I Edition, Massachusetts, A.Benjamin Inc.,1966

Online resource:

1. <http://eacharya.inflibnet.ac.in/> Physical Chemistry-I (Quantum Chemistry) [32 lectures]

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	3	3	2	2	3	3	3	3	3	2	2.7
CO2	3	2	3	3	2	3	3	2	3	3	2	2.6
CO3	3	3	2	2	2	3	3	3	3	2	3	2.7
CO4	3	3	3	2	3	3	3	3	3	3	3	2.9
CO5	3	3	2	3	2	2	3	3	3	3	2	2.5
CO6	3	2	3	3	2	3	3	3	3	3	3	2.7
Mean Overall Score												2.6
Result												High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10



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Semester – II

Hours: 5 / Credit: 5

Subject Code: CC207

Core: Principles of Marketing

Course objectives:

- To make students to aware of marketing concepts and elements of marketing Mix
- To enhance the knowledge about Market segmentation, Marketing information system and Marketing Research
- To make the students to understand the product classification and product life cycle
- To know the different types of pricing and promotional strategies in realistic marketing situations
- To impart knowledge on technological marketing

Course Outcomes:

CO	CO - Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO1	Understand the importance of marketing and summarize role of marketing Mix	K1, K2
CO2	Use the market information and Research to develop new marketing strategies for organizations	K6
CO3	Develop the product planning process through the concept of product life cycle.	K5, K6
CO4	Analyzing the different types of pricing strategy and deciding the promotion tools based on marketing environment.	K4
CO5	learned about the technology in marketing and used in their day today life to buying goods and services	K3

COS	Programme Outcome							Programme Specific Outcome					Mean Score of CO's
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	2	2	3	3	3	3	3	2	3	2.67
CO2	2	3	3	3	2	3	2	2	3	3	2	3	2.58
CO3	3	2	2	3	3	2	2	3	3	3	3	2	2.58

CO4	3	2	2	2	2	3	3	3	2	2	3	2	2.42
CO5	2	3	3	3	3	2	3	3	2	2	3	3	2.67
Mean Overall Score													2.58

Unit - I: Basics of Marketing

Meaning and Definition of Marketing - Features, scope and importance of marketing - Modern concept of marketing - Functions of marketing, Marketing Mix – The elements of marketing mix

Unit – II: Marketing Segmentation and Research

Market Segmentation: Meaning - Bases for Market segmentation; Market Research: Meaning - Objectives and Process; Marketing Information System: Meaning - Importance – Marketing Research Vs MIS

Unit – III: Product

Meaning - definition - Characteristics and Classification of products - Product mix decision - Product life cycle - Product planning - New product development process

Unit – IV: Pricing and Promotion

Pricing: Meaning and objective - Factors influencing pricing decisions - Price determination - Pricing methods, Policies and strategies. Promotion – Objectives and types of promotion – promotional Mixes and strategies

Unit –V: Technological Marketing

Online Shopping: Meaning, benefits and limitations - Mobile Marketing: Meaning and Strategies - **Green Marketing**, Relationship marketing and Virtual Marketing: Meaning, nature and importance - Social criticisms of Marketing

Field Activities:

- Every student should Visit the market and conduct a mini survey on any one of the marketing concepts with 20 questions and submit the report by applying the MS Word and Excel.
- Every student should create an original Virtual Advertisement for 2 minutes.
- Every student should prepare a list of 5 products/brands each stages of Product Life Cycle with the reason.

Text Book:

- R.S.N. Pillai and Bhagavathi, Modern Marketing, S. Chand & Company, New Delhi 2016

Reference Books:

1. Philip Kotler, Marketing Management, PHI Learning PvtLtd.2009
2. David Meerman Scott, The New Rules of Marketing & PR, John Wiley & Sons, Inc, Hoboken, New Jersey, 5th Edition.2013
3. Dr.C.B.Gupta and Dr.N.RajanNair, Marketing Management, Sultan Chand & Sons 2005.
4. Sontakki C.N, Marketing Management, Kalyani Publications, Ludhiana 2009.

Course Objectives

- To provide a global and local perspective on tourism marketing
- To build theoretical knowledge of the tourism marketing and related sectors
- To understand about the behaviour of tourists.
- To gain knowledge of tourism market segmentation.
- To enable the students to be familiar with tourism planning process.

Course outcomes:

On successful completion of this course, students will be able to		
CO	CO – Statements	Cognitive Levels (K –Levels)
1	Aware about the basics of tourism and effects of tourism	K1 - K4
2	Apply the tourism marketing of developed countries in India.	K1 - K4
3	Understand about the behaviour of tourist	K1 - K4
4	Analyse the tourism planning process and regional planning	K1 – K5
5	Understand about the tourism market segmentation	K1 - K4
	K1 -Remember; K2 -Understand; K3 -Apply; K4 -Analyze; K5-Evaluate; K6 –Create	

COS	Programme Outcome							Programme Specific Outcome					Mean Score of CO's
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	2	3	3	2	3	2	3	3	2	2	2.50
CO2	3	2	2	2	3	3	3	3	2	3	3	2	2.58
CO3	2	3	2	3	3	2	3	2	3	2	3	2	2.50
CO4	2	3	3	3	2	3	3	2	2	3	3	2	2.58
CO5	3	2	3	3	2	3	2	3	3	2	3	3	2.67
Mean Overall Score												2.57	

Unit – I: Introduction to Tourism:

Tourism: Concept, Tourist: Concept, Motives Behind Travel, Tourism: Typology, Tourism: An Industry, Effect of Tourism, Tourist Organizations, Market Potential of Tourism.

Unit- II: Tourism Marketing:

The Perception, Why Tourism Marketing? Purpose of Tourism Marketing, Significance of Tourism Marketing, Tourism Marketing in the Developed Countries, Tourism Marketing in Indian Environment

Unit – III: User's Behavioural Profile:

Users: a General Description, Users' Behaviour, Behavioural Influence, Users' Behaviour and Life Style, Typology of Users' Behaviour, Behaviour Determinants Model, Understanding the Behaviour of Tourism, Psycho-locomotion of Tourists

Unit – IV: Tourism Product Planning and Development:

Product - the Concept, A View of the Tourism Product, Tourism Product - The Salient Features, Tourism Product Planning, Why Product Planning? Planning Process, **Environment and Planning**, Regional Planning, Appraisal of Project and Tourism Planning, Tourism Product Planning in India.

Unit –V: Tourism Market Segmentation:

Concept of Tourism Market, Concept of Market Segmentation - Justification for Segmenting the Market, Importance of Market Segmentation, Bases of Market Segmentation, Life Style: An Importance Base, Effective Market Segmentation, Decision Processes for Segmentation.

Text Book:

- Tappan K Panda and Sitikantha Mishra, Tourism Marketing – The ICFAI press Hyderabad 2006

Reference Books:

1. Biswanath Ghosh, Tourism and Travel Management – Vikas Publishing New Delhi 2003
2. Suddhendu Mishra, Basic of Tourism Management – Excel books, New Delhi 2008
3. Monika Prakash and Nimit Chowdhary, Starting a Tourism Company – Matrix publishers New Delhi 2010
4. Anil sharma, Tourism Management – Essential books, New Delhi 2006

Course Objectives:

- To enable the students to have an overview of Political, Social and Global environment of business
- To provide knowledge of the environment in which businesses operate, the economic environment
- To give students an understanding of the various constituents and its functions.
- To study the procedural aspects of various forms of Business Organizations and Social Responsibility of Business towards different groups
- Gain knowledge about the operation of different institutions and opportunities of global business environments.

Course Outcomes:

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

CO	CO – Statements	Cognitive Levels (K –Levels)
CO1	Familiarize the nature and scope of business environment and its components	K1 - K4
CO2	Understand the effects of government policy on the economic environment	K1 - K4
CO3	Have knowledge on social responsibility of business towards stakeholders	K1 - K4
CO4	Analyze the relationships between Government and political environment	K1 - K4
CO5	Make aware on the role of globalization, WTO and GATT	K1 - K4

COS	Programme Outcome							Programme Specific Outcome					Mean Score of CO's
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	3	2	3	2	3	2	3	3	3	2.67
CO2	3	3	2	3	2	2	3	3	2	2	3	2	2.50
CO3	2	3	3	2	3	3	3	2	3	3	2	2	2.58
CO4	2	3	3	3	3	2	3	3	3	3	2	3	2.75
CO5	3	2	2	3	3	2	3	3	2	3	3	3	2.67
Mean Overall Score												2.63	

Unit – I: Business Environment

Meaning and Definition of business – Scope of Business – Characteristics of Business – Business goals – Business during the 21st century - Knowing the environment – Factors influencing the Indian Business Environment – Environmental Analysis

Unit - II: Economic Environment

Economic Environment – Nature of the Economy – Structure of the Economy – Economic Policies & Planning the economic conditions.

Unit – III: Political Environment

Political & Government Environment – Functions of the State – Economic Roles of the government – Government and Legal Environment – The constitutional Environment

Unit – IV: Social Environment

Social Environment – Business and Society Ecology and Consumerism, Consumer rights – Business Ethics – Social Responsibility of Business towards stakeholders – Natural Environment and Ecology

Unit –V: Global Environment

Global Environment – globalization – Meaning and Rationale for globalization – the role of WTO – GATT – trading blocks in globalization – Impact of globalization on India

Text Book:

- S.Sankaran , Business Environment, Margham Publications, Chennai 2015

Reference Books:

1. K. Aswathappa, Essentials of Business Environment, Himalaya Publishing House, Delhi 2016
2. Raj Agarwal , Business Environment, Excel Books, New Delhi 2002
3. Dr. Francis Cherunilam, Business Environment, Himalaya Publishing House, Delhi 2015
4. Sundaram & Black: The International Business Environment; Prentice Hall, New Delhi. 2011



SACRED HEART COLLEGE (AUTONOMOUS)

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B.Sc. Microbiology - Programme Structure (Revised with effect from 2021 - 2022 Onwards)

Sem	Part	Subject Code	Subject Title	Hrs	Credit (s)	E - Hrs	CA	SE	Total
I	I	LT114	Tamil – I	5	3	3	50	50	100
	II	LE115AT	English – I	5	2	3	50	50	100
	III	ABC102	Allied Biochemistry – I	4	3	3	50	50	100
	III	PABC102	Allied Practical – I	2	1	3	40	60	100
	III	MB103	Fundamentals of Microbiology	4	4	3	50	50	100
	III	MB104	Microbial Diversity and Classification	3	3	3	50	50	100
	III	PMB102	Main Practical – I	3	3	3	50	50	100
	IV	SK104	Communication Skills	2	1	-	-	-	-
	IV	VE105A/ VE105B	Christian Religion – I/Value Education - I	2	1	3	50	50	100
	IV	CE103	Communicative English – I	-	1	-	-	-	-
Total				30	22	-	-	-	-
II	I	LT214	Tamil – II	5	3	3	50	50	100
	II	LE215AT	English – II	5	2	3	50	50	100
	III	ABC202	Allied Biochemistry – II	4	3	3	50	50	100
	III	PABC202	Allied Practical – II	2	1	3	50	50	100
	III	MB203	Microbial Physiology and Metabolism	4	4	3	50	50	100
	III	MB204	Bioinstrumentation	3	3	3	50	50	100
	III	PMB202	Main Practical – II	3	3	3	50	50	100
	IV	SK204	Leadership Skills	2	1	-	-	-	-

	IV	VE205A/ VE205B	Christian Religion – II/Value Education - II	2	1	3	50	50	100
	IV	CE203	Communicative English – II	-	1		-	-	-
Total				30	22	-		-	-
III	I	LT312	Tamil – III	5	3	3	50	50	100
	II	LE309T	English – III	5	2	3	50	50	100
	III	AM310C	Allied Biostatistics – I	6	5	3	50	50	100
	III	MB303	Immunology	4	4	3	50	50	100
	III	MB304	Mushroom Technology	3	3	3	50	50	100
	III	PMB302	Main Practical – III	3	3	3	50	50	100
	IV	SK304	Technical Skills	2	1		-	-	-
	IV	VE306	Human Rights	2	1	3	50	50	100
	IV	LE309P	English Lab - III	-	1	-	50	50	100
Total				30	23	-	-	-	-
IV	I	LT411	Tamil – IV	5	3	3	50	50	100
	II	LE409T	English – IV	5	2	3	50	50	100
	III	AM409C	Allied Biostatistics – II	6	5	3	50	50	100
	III	MB404	Bioinoculant Technology	4	4	3	50	50	100
	III	MB405	Microbial Genetics	3	3	3	50	50	100
	III	PMB402	Main Practical – IV	3	3	3	50	50	100
	IV	SK404	Employment Skills	2	1	-	-	-	-
	IV	VE406	Environmental Science	2	1	3	50	50	100
	IV	LE409P	English Lab IV	-	1	-	50	50	100
	V		Outreach Programme	-	2	-	-	-	-
	V		SHELTERS	-	2	-	-	-	-
III		Internship	-	2*	-	-	-	-	
Total				30	27 + 2*	-	-	-	-
Sem	Part	Subject Code	Subject Title	Hrs.	Credit (s)	E – Hrs	CA	SE	Total
V	III	MB508	Molecular Biology and Genetic Engineering	4	4	3	50	50	100

	III	MB509	Medical Bacteriology	5	5	3	50	50	100
	III	MB510	Medical Virology	5	4	3	50	50	100
	III	MB511	Medical Mycology and Parasitology	5	4	3	50	50	100
	III	PMB502	Main Practical – V	5	4	6	50	50	100
	III		Major Elective – I	4	3	3	50	50	100
		MB512A	a) Public Health Microbiology						
		MB512B	b) Bioinformatics and Chemoinformatics						
		MB512C	c) Pharmaceutical Microbiology						
			(One out of three)						
	III	NMB502	Non – Major Elective – I	2	1	3	50	50	100
	III	-	SSP – 1: Entrepreneurship Microbiology	-	1*	-	-	-	-
Total				30	25 + 1*	-	-	-	-
VI	III	MB608	Microbial Biotechnology	4	4	3	50	50	100
	III	MB609	Environmental Microbiology	5	5	3	50	50	100
	III	MB610	Vermitechnology	4	3	3	50	50	100
	III	MB611	Food Microbiology	5	5	3	50	50	100
	III	MB612	Industrial Microbiology	5	5	3	50	50	100
	III	PMB602	Main Practical – VI	5	4	6	50	50	100
	III	NMB602	Non – Major Elective – II	2	1	3	50	50	100
	III	-	SSP – 2: Probiotic Microbiology	-	1*	-	-	-	-
	III	-	Group Project	-	1*	-	-	-	-
	III	-	NPTEL/MOOCs/Other Certificate courses	-	1*	-	-	-	-
Total				30	27 + 3*	-	-	-	-

TOTAL HOURS = 180 Hours

TOTAL CREDITS = 146 + 2 *(SSP 1 & SSP 2) + 2 *Internship + 1 *Group project + 1* from NPTEL/ MOOCs/Other Certificate courses.

SUBJECT CODE: MB 104
CORE PAPER II: MICROBIAL DIVERSITY AND CLASSIFICATION

Objectives

- To learn the Taxonomy of microorganisms.
- To analyze the Ultrastructure of Fungi, Algae and Protozoa.
- To understand the Classification of microorganisms.
- To recognize the fundamentals on Economic importance of microorganisms.
- To impart knowledge on Molecular identification of microorganisms.

Course Outcomes

The basic task of Microbial Diversity and Classification is to differentiate the various characteristics of microorganisms based on Ultrastructure and Classification. It enables the students to identify any microorganisms through Molecular identification. The students will be able to understand and predict the Economic importance of microorganisms.

S.No.	Description	Cognitive Level (K-level)
CO-1	Understand the knowledge of Classifications and Taxonomy of Microorganisms in detail	K2, K3
CO-2	Acquire the basic knowledge on the Ultrastructure, Classification, Mode of nutrition and Reproduction of Fungi, Algae and Protozoa.	K3
CO-3	Discuss the Economic importance of Fungi, Algae and Protozoa.	K2
CO-4	Examine and define the structure, properties and classification of Human, Plant and Animal viruses.	K1
CO-5	Explore and recommend the Molecular techniques applied in identification of microorganisms.	K4, K5
CO-6	Compile the basic information on the diversity and classification of Fungi, Algae, Protozoa and Algae.	K6

Unit – I

Phylogenetic Hierarchy; Nomenclature of Microorganisms; Taxonomy and Taxonomic Hierarchy; Kingdom concept of Organisms classification – Linnaeus Two Kingdom concept, Haeckel Three Kingdom concept, Copeland's Four Kingdom concept, Whittaker's Five Kingdom concept, Grey & Doolittle's Six Kingdom concept and Cavalier-Smith's Eight Kingdom concept; Wose – Fox's Three Domains of Life; Genetic and Intraspecies Classification; Classification of Bacteria - Bergey's manual and its importance; Economical importance of Bacteria.

Unit – II

Fungi – Ultrastructure, Nutrition and Reproduction; Characteristics of Molds & Yeasts; Classification of Fungi; Budding in Yeast; Fungal identification (Microscopic examination) and Cultivation in Culture medium; Water molds; Economical importance of Fungi.

Unit – III

Algae – Ultrastructure and Nutrition; Role of Algae in Nature; Classification of Algae; Diatoms and Dinoflagellates; Lichens; Algal diseases of humans; Algal identification (Microscopic examination) and Cultivation in Culture medium; Economical importance of Algae.

Unit – IV

Protozoa - Ultrastructure, Classification and Nutrition; Microscopic examination of Protozoa; Slime Molds – Cellular Slime Molds & Plasmodial Slime Molds; Economic importance of Protozoa; Virus – Structure and Classification; Animal and Plant Viruses; Viroids and Prions.

Unit – V

Molecular Identification of Microorganisms – Fatty acid profiles, DNA Base composition (G + C Content), DNA Fingerprinting, Polymerase Chain Reaction (PCR), CRISPR and Nucleic acid Hybridization (Southern Blotting, DNA Chips, FISH and rRNA Sequencing).

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)									Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	
1	3	2	2	3	3	2	3	2	3	3	2	3	3	3	2	2	2.5
2	3	2	3	3	2	3	2	2	2	2	3	3	2	2	3	2	2.4
3	1	2	2	3	2	2	3	3	1	3	2	2	2	2	3	3	2.2
4	3	3	2	2	2	2	1	2	3	2	3	3	2	3	3	2	2.3
5	2	2	3	1	3	2	2	2	2	1	2	2	3	2	2	2	2.0
6	3	3	1	2	3	2	3	3	2	3	2	3	2	3	2	3	2.5
Mean Overall Score																2.3	
Result																High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Text Books

- Gerard J. Tortora, Berdell R. Funke and Christine L. Case. 2015. Microbiology – An Introduction, 12th Edition, Peareson Publishers, San Francisco.
- Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.

References

- Chakraborty. 2003. A Text book of Microbiology. 2nd Edition, Published by New Central Book Agency (P) Ltd., Kolkata.
- Dubey, R.C. and D. K. Maheswari. 2010. A Text book of Microbiology. 3rd Edition, S. Chand and Company, New Delhi.
- Pelczar Jr. M. J., Chan, E. C. S and Kreig, N. R. 2006. Microbiology. 5th Edition Mc Graw Hill Inc. New York.
- Powar, C. B and H. F. Dagainawala. 2008. General Microbiology. Volume – II, Himalaya Publishing House, Mumbai.

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Checked by CDC Name : Signature :	Approved by COE Name : Signature :

SUBJECT CODE: MB 203
CORE PAPER III: MICROBIAL PHYSIOLOGY AND METABOLISM

Objectives

- To analyze the Nutrient requirements and Nutrition types of microorganisms.
- To observe the Transport of Nutrients in Microorganisms.
- To study the Microbial growth and its measurement.
- To learn the Microbial metabolism and respiration.
- To understand the Photosynthesis reaction in microorganisms.

Course Outcomes

The paper Microbial Physiology and Metabolism enables the students about to know about Microbial nutrition and growth. The students will also be able to understand and predict the Intermediate metabolism and Photosynthesis of microbes.

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Help learners to define and understand the objectives of Microbial physiology, Microbial nutrition and Microbial metabolism.	K1, K2
CO-2	Analyze and understand the basic concepts of Nutrient requirements and Nutrition types of microorganisms.	K4
CO-3	Provide students with learning experiences that help in still deep interests in learning Transport of nutrients in Microorganisms.	K3
CO-4	Develop broad and balanced knowledge and understanding of Microbial growth, Growth measurement and Preservation of microorganisms.	K6
CO-5	Equip students with appropriate knowledge on Microbial metabolism which includes Catabolism and Anabolism.	K4
CO-6	Recommend students to find the Photosynthetic reaction in microorganisms.	K5

Unit – I

Microbial Nutrition – Chemical nutrient requirements and Growth factors, Nutritional groups of microorganisms; Uptake of nutrients by cells: Passive transport - Simple diffusion, Facilitated diffusion and Osmosis; Active transport – ABC Transporters, Group translocation, Exocytosis and Endocytosis (Phagocytosis and Pinocytosis); Iron uptake by microorganisms.

Unit – II

Cell division in Bacteria (Binary fission); Microbial Growth – Generation time and Growth Curve; Influence of environmental factors on growth; Measurement of microbial growth – Direct and Indirect methods; Continuous culture of microorganisms - Chemostat; Diauxic growth and Synchronous growth; Preservation of microbial cultures.

Unit – III

Microbial Metabolism – Difference between Catabolism and Anabolism; Fermentation and its types; Generation of ATP - Substrate level Phosphorylation, Oxidative Phosphorylation and Electron transport chain; Carbohydrate catabolism – Glycolysis, Phosphoketolase pathway and Entner Doudoroff pathway.

Unit – IV

Microbial Respiration - Aerobic and Anaerobic respiration by microorganisms; Aerobic Respiration – Krebs's cycle; Biosynthesis of Bacterial cell wall polysaccharides, Purines, Pyrimidines, Amino acids and Fatty acids; Anaerobic Respiration – Acetogenesis and Methanogenesis.

Unit – V

Photosynthesis; Diversity of photosynthetic organisms; Difference between plant, algal and bacterial photosynthesis; Photosynthetic pigments; Light reaction (Photophosphorylation) and Dark reaction (Calvin cycle).

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)									Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	
1	3	2	3	3	3	2	3	2	3	3	2	3	3	3	3	2	2.6
2	3	2	3	3	2	3	2	2	3	2	3	3	3	2	3	2	2.5
3	2	2	2	3	2	2	3	3	2	3	2	2	3	2	3	3	2.4
4	3	3	2	2	3	2	2	2	3	2	3	3	3	3	3	2	2.5
5	3	2	3	2	3	2	2	3	2	2	2	3	3	2	2	3	2.4
6	3	3	2	2	3	2	3	3	2	3	3	3	3	3	2	3	2.6
Mean Overall Score																	2.5
Result																	High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Text Books

- 1) Gerard J. Tortora, Berdell R. Funke and Christine L. Case. 2015. Microbiology – An Introduction, 12th Edition, Peareson Publishers, San Francisco.
- 2) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 3) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.

References

- 1) Caldwell, D.R., 2008. Microbial Physiology and Metabolism. Wm C Brown Publishers, England.
- 2) Chatterjee, N and Rana Shinde. 2012. Textbook of Medical Biochemistry, 8th edition, Jaypee publication, New Delhi.
- 3) Dubey, R.C. and D. K. Maheswari. 2010. A Text book of Microbiology. 3rd Edition, S. Chand and Company, New Delhi.
- 4) Pelczar Jr. M. J., Chan, E. C. S and Kreig, N. R. 2006. Microbiology. 5th Edition Mc Graw Hill Inc. New York.

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SUBJECT CODE: MB 609

CORE PAPER XIV: ENVIRONMENTAL MICROBIOLOGY**Objectives**

- To create the awareness about environmental problems among people.
- To provides a comprehensive overview of Biogeochemical processes relevant to environmental scientists and engineers mediated by microorganisms.
- To study about the water borne pathogens, water borne disease, microbial standards of water quality, biogenic pollution, air borne microbes and waste water management.
- To learn the Microbe Interactions and Plant – Microbe Interactions in connection with Biogeochemical cycles.
- To understand the concept of Solid waste and Liquid waste treatment.

Course Outcomes

The paper Environmental Microbiology will create awareness about Microbes and environment, distribution, diversity and ecological importance, characteristics of microorganisms in different environment and its Biogeochemical cycle. This paper will also provides a detailed knowledge on Waste water treatment technologies.

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Assess the role and importance of microorganisms in Atmosphere, Hydrosphere and Pedosphere.	K5
CO-2	Understanding the role of microorganism in recycling Soil nutrients through Biogeochemical cycles.	K2
CO-3	Provides a detailed knowledge on Solid waste and Waste water treatment technologies.	K1, K3
CO-4	Create an awareness to students with Microbe Interactions and Plant – Microbe Interactions in connection with Biogeochemical cycles.	K6
CO-5	Point out the general principles in the field of Environmental Microbiology.	K4
CO-6	Gain knowledge about Bioremediation and Biodegradation.	K3

Unit – I

Organization of the Biosphere; Ecosystem and its types; Major role of Microorganisms in Ecosystem; Atmosphere – Relationship between Microorganisms and Atmosphere; Sampling of Air; Aeroallergens; Air borne disease caused by Bacteria, Fungi and Viruses; Air pollution; Green-house effect; Air Sanitation; CO₂ sequestration.

Unit – II

Terrestrial Ecosystem – Importance of Soil; Formation of Soil; Soil characteristics (Physical & Chemical); Soil Microbiology – Major group of Soil microorganisms; Qualitative microflora of soil (Bacteria, Actinobacteria, Fungi, Viruses, Algae & Protozoa); Soil types and their microflora; Quantification of Soil microflora; Role of microorganisms in Soil fertility.

Unit – III

Aquatic ecosystem – Types of Aquatic ecosystem - Fresh water ecosystem, Marine ecosystem, Estuarine ecosystem and Mangrove ecosystem; Water zonations; Eutrophication; Winogradsky column; Water pollution; Bacteriological analysis of water; Water borne diseases; Purification of water; Recycling of water.

Unit – IV

Organic matter decomposition; Formation and composition of Soil organic matter - Fulvic acid & Humic acid; Biogeochemical cycles – Carbon cycle, Nitrogen cycle, Phosphorous cycle, Sulphur cycle and Iron cycle; Microbe – Microbe Interactions; Plant – Microbe Interactions.

Unit – V

Solid waste management - Incineration, Composting & Sanitary landfill; Sewage treatment – Small scale sewage treatment (Cesspools, Septic tank & Imhoff's tank) and Large scale sewage treatments (Primary treatment, Secondary treatment, Tertiary treatment & Anaerobic Sludge Digestion); Xenobiotics; Bioremediation, Biodegradation; Bioaccumulation; Bioleaching; Biodeterioration; Current Research Thoughts in Environmental Microbiology.

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)									Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	
1	3	3	2	2	3	3	3	3	3	3	2	3	3	3	2	3	2.7
2	2	2	3	3	2	3	1	2	3	2	3	3	2	2	3	2	2.3
3	3	1	2	3	1	3	3	3	2	3	2	2	3	3	2	3	2.4
4	2	2	3	2	3	2	2	2	3	3	3	3	3	3	3	2	2.5
5	2	3	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2.1
6	3	2	2	3	3	2	3	3	2	3	3	3	3	3	2	3	2.6
Mean Overall Score																	2.5
Result																	High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Text Books

- 1) Vijaya Ramesh, K. 2008. Environmental Microbiology, MJP Publishers, Chennai, India.
- 2) Subba Rao N.S. 1999. Soil Microbiology, 4th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
- 3) Saranraj, P and P. Sivasakthivelan. 2020. Textbook of Environmental Microbiology. JPS Scientific Publications, India.

References

- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Patel, A. H. 2016. Industrial Microbiology, 2nd Edition, Laxmi Publications, New Delhi, India.
- 3) Madigan, M. T., J. M. Martinko and J. Parker. 2009. Brock's Biology of Microorganisms, 12th Edition, Pearson/Benjamin Cummings, New York.
- 4) Maier, R. M., I. L. Pepper and C. P. Gerba. 2009. Environmental Microbiology, 2nd Edition, Academic Press, United States.

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