YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY

Syllabus for

Course-Work

R91: Ph.D.

(Chemistry){2019 Pattern}

2019

YCMOU, NASHIK-422 222, MH, INDIA

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BASIC INFORMATION

1. **Mode of Education**: Regular
2. **Minimum Programme Duration**: 1 Semester
3. **Required Study Efforts**: Total 36 Hours (including Self-Study) during 1 semester.
4. **Medium of Instruction**: English
5. **Attendance**: Minimum **75 %** attendance shall be essential.

PROGRAMME CALENDAR

1. **Teaching-Learning and Continuous Assessment**: Feb-May
2. **Continuous Assessment Seminar**: April/ May
3. **End Examination**: During May/June

PROGRAMME STRUCTURE

Course ➔ Sem⬇	Course 01, 4CP, T	Course 02, 4 CP, T	Course 03, 4 CP, T
Sem 01 12 CP	**RES101**: Research Methodology	**RES135**: Applications of Analytical Techniques in Chemistry	**RES136**: Organic Chemistry

SEMESTERS AND COURSES

SN	Code	Name	CA	EE	TM	Type	Credits
Semester 01: 12 Credits							
01	RES101	Research Methodology	50	50	100	T	4
02	RES135	Applications of Analytical Techniques in Chemistry	50	50	100	T	4
03	RES136 **or**	Organic Chemistry	50	50	100	T	4
04	RES137 **or**	Inorganic Chemistry	50	50	100	T	4
05	RES138 **or**	Physical Chemistry	50	50	100	T	4
06	RES139	Analytical chemistry	50	50	100	T	4

Note: Student has to select one course from RES136/ RES137/ RES138 and RES139

Evaluation Pattern

SN	Type of Course	Continuous Assessment	End Examination
1	**Theory (T)**	Seminar, Viva and Report Total**50**Marks which consist of (1) Presentation: 20Marks (2) Viva: 20Marks (3) Report:10 Marks during total **20**minutes	Closed Book Summative Evaluation with supervision at Exam Center. Conducted on prescheduled date and time. **50** Marks, Total **10** SAQs each of **05 Marks,** **05** SAQs each of 05 Marks on both CP 1 & 2 and **05** SAQs each of 05 Marks on both CP3 & 4 during total **90** minutes.

Actual CA and EE marks shall be added to compute "Total Marks (TM)". "CA, EE and Total marks" shall be separately reported for each course in the mark-statement. Only best of the past performance shall be reported.

Guidance for PhD Research

Subject wise Ph.D. research supervisors allotted to each student shall guide to the students whenever required by the students through email, on phone or during face-to-face meetings.

Student shall submit request letter along with the six monthly progress report signed by the resp. research supervisors to the Director of the School to organize Doctoral Research Committee meeting for the approval of the research progress of the student.

SEMESTER 01

RES101: RESEARCH METHODOLOGY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: **http://ycmou.digitaluniversity.ac.in** and **http://www.ycmou.ac.in/**
2	School	School of Architecture, Science and Technology (AST)
3	Discipline	Chemistry
4	Level	Research
5	Course Used in	R91: Ph.D. (Chemistry)

COURSE INFORMATION

Sem	Code	Course Name	CP	CA	EE	TM	Type
01	RES101	Research Methodology	4	50	50	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have: • Successfully completed Post-Graduate Degree programme and • PhD Entrance Test	After successful completion of this course, student should be able to • Select and Use Appropriate Research Methodology and Techniques for Research. • Develop research proposal and to work with research problem

UNITS

UN	Name of the Unit	CSs
01 02	Research methodology & Literature review Analysis of Literature Review	CR 01 CSs 3hrs
03 04	Method of Data Collection Scientific technical writing	CR 02 CSs 3hrs

05	Computational knowledge	**CR 03** **CSs** **3hrs**
06	Intellectual property rights	**CR 04** **CSs** **3hrs**

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	Credit
01	**Research methodology & Literature review:** Science and Research: Definition – History – Evolution of Scientific Inquiry, Scientific Research: Definition, Characteristics, types, Need of research. Identification of the problem, assessing the status of the problem, formulating the objectives, preparing design (experimental or otherwise), Actual investigation. Introduction to Research Methodology Meaning and importance of Research – Types of Research – Selection and formulation of Research Problem Research Design – Need – Features – Inductive, Deductive and Development of models Developing a Research Plan – Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Designs.	**CR 01**
02	**Analysis of Literature Review** : Primary and Secondary Sources, Web sources –critical Literature Review Hypothesis – Different Types – Significance – Development of Working Hypothesis, Null hypothesis Research Methods: Scientific method Vs Arbitrary Method, Logical Scientific Methods: Deductive, Inductive, Deductive-Inductive, pattern of Deductive – Inductive logical process – Different types of inductive logical methods, chemical safety & disaster management.	
03	**Method of Data Collection:** Data Collection and Analysis Sources of Data – Primary, Secondary and Tertiary – Types of Data – Categorical, nominal & Ordinal. Methods of Collecting Data: Observation, field investigations, Direct studies – Reports, Records or Experimental observations. Sampling methods – Data Processing and Analysis strategies- Graphical representation – Descriptive Analysis – Inferential Analysis- Correlation analysis – Least square method - Data Analysis using statistical package – Hypothesis – testing – Generalization and Interpretation – Modeling.	**CR 02**

04	**Scientific technical writing:** Scientific Writing Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports - Illustrations and tables – Bibliography, Referencing and foot notes –Importance of Effective Communication. Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, ISBN & ISSN. Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – Budget and Justification – References Documentation and scientific writing Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography.	
05	**Computational knowledge:** Basic rules of sophisticated storage and retrieval of data, development of database structures and data base management, data processing and basic operation, sorting, indexing and primary keys, Network protocols, Development of web page, search of chemical in computer networks. Computer applications and Statistics Use of word processing spread sheet and database software. Plotting of graphs. Internet and its application: E-mail, WWW, Web browsing, acquiring technical skills, drawing inferences from data, Introduction to Statistics – Probability Theories - Conditional Probability, Poisson distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi Square Test, Association of Attributes t Test –ANOVA, Standard deviation Coefficient of variations. Correlation and Regression Analysis.	**CR 03**
06	**Intellectual property rights:** General introduction, patents and copyrights, Designs patents and copyrights, patent drafting, patent claims and specifications, trademarks, trade integrated circuit, patent life and geographical boundaries, utilization of intellectual patents, patent search, patent acts & Rules, legal decision making process. Ownership of patents, Author and ownership of copyright. Licensing of copyrights, Infringement of copyrights and patents, Remedies & action for infringement of copyrights IPR as protection Strategy. Patent cooperation treaty (PCT), Indian and US patent Acts and Latest amendments. Ethics Ethical Issues – Ethical Committees – Commercialization – copy right – royalty – Intellectual Property rights and patent law – Track Related aspects of intellectual property Rights – Reproduction of published material – Plagiarism – Citation and Acknowledgement – Reproducibility and accountability.	**CR 04**

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Reference Books			
RES101-R01	Research Methodology Methods and Techniques - C. R. Kothari	2004	978-81-224-2488-1New Age
RES101-R02	Fundamental of Research Methodology and Statistics - Yogesh Singh	2006	978-81-224-2418-8 New Age

RES 135: Applications of Analytical Techniques in Chemistry

Programme Information

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: **http://ycmou.digitaluniversity.ac.in** and **http://www.ycmou.ac.in/**
2	School	School of Architecture, Science and Technology (AST)
3	Discipline	Chemistry
4	Level	Research
5	Course Used in	R91: Ph.D. (Chemistry)

Course Information

Sem	Code	Course Name	CP	CA	EE	TM	Type
01	RES135	Applications of Analytical Techniques in Chemistry	4	50	50	100	T

Presumed Knowledge and Learning Objectives

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have: • Successfully completed Post-Graduate Degree programme and • PhD Entrance Test	After successful completion of this course, student should be able to: • Explain investigation methodologies in chemistry; • Develop independent investigation that meet the requirements imposed by international academic standards; • Develop a significant number of original research projects that have provided contributions to the growing knowledge in chemistry, and which can be published in national and international refereed scientific publications; • Perform critical analysis, to evaluate and to synthesize new and complex ideas; • Communicate the results of their work to other geologists, academic community and society;

	• Promote the technologic, scientific, social and cultural progress.

UNITS

UN	Name of the Unit	CSs
01 02 03	Ultraviolet UV and visible spectroscopy Infrared spectroscopy (IR) Nuclear magnetic resonance spectroscopy (NMR)	CR 01 CSs 3hrs
04 05 06	Fluorescence spectroscopy Electro analytical techniques Thermal analysis	CR 02 CSs 3hrs
07 08 09	CHNS Analyzer Chromatography Single crystal X-ray structures, Supramolecular chemistry and DFT Computation	CR 03 CSs 3hrs
10 11 12	Surface characterization techniques TEM, SEM and particle size analysis Mass spectroscopy	CR 04 CSs 3hrs

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CP
01	Principles and Techniques of Ultraviolet UV and visible spectroscopy	CR 01
02	Principles and Techniques of Infrared spectroscopy (IR)	
03	Principles and Techniques of Nuclear Magnetic Resonance Spectroscopy (NMR)	
04	Principles and Techniques of Fluorescence spectroscopy	CR 02
05	Electro analytical techniques	
06	Thermal analysis	

07	Principles and Techniques of CHNS Analyzer	CR 03
08	Principles and Techniques of Chromatography	
09	Single crystal X-ray structures, Supramolecular chemistry and DFT Computation	
4-1	Surface characterization techniques	CR 04
4-2	TEM, SEM and particle size analysis	
4-3	Principles and Techniques of Mass spectroscopy	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Reference Books			
RES135-R01	Applications of Spectroscopy of organic compounds – J. R. Dyer	-	Prentice Hall
RES135-R02	Principles and practice of analytical chemistry – Fifield F. W and Kealey D.	-	Black Well science

RES 136: Organic Chemistry

Programme Information

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: **http://ycmou.digitaluniversity.ac.in** and **http://www.ycmou.ac.in/**
2	School	School of Architecture, Science and Technology (AST)
3	Discipline	Chemistry
4	Level	Research
5	Course Used in	R91: Ph.D. (Chemistry)

Course Information

Sem	Code	Course Name	CP	CA	EE	TM	Type
01	RES136	Organic Chemistry	4	50	50	100	T

Presumed Knowledge and Learning Objectives

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have: • Successfully completed Post-Graduate Degree programme and • PhD Entrance Test	After successful completion of this course, student should be able to: • Explain investigation methodologies in chemistry; • Develop independent investigation that meet the requirements imposed by international academic standards; • Develop a significant number of original research projects that have provided contributions to the growing knowledge in chemistry, and which can be published in national and international refereed scientific publications; • Perform critical analysis, to evaluate and to synthesize new and complex ideas; • Communicate the results of their work to other geologists, academic community and society;

	• Promote the technologic, scientific, social and cultural progress.

UNITS

UN	Name of the Unit	CSs
01	Advances in designing and synthesis of organics - 1	CR 01 CSs 3hrs
02	Advances in designing and synthesis of organics - 2	CR 02 CSs 3hrs
03	Advanced stereochemistry and asymmetric synthesis	CR 03 CSs 3hrs
04 05	Structural elucidation of organic and complex organics Biological activity evaluation and computational studies	CR 04 CSs 3hrs

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CP
01	**Advances in designing and synthesis of organics - 1:** Newer methods of C-C and C-Heteroatom bond formation reactions and functional group transformations, Advances in retro synthetic analysis.	CR 01
02	**Advances in designing and synthesis of organics - 2:** Advances in Homo, Heterogeneous and biocatalysis and biomimetic catalysis, advances in greener tools and their role in rate acceleration in organic transformations.	CR 02
03	**Advanced stereochemistry and asymmetric synthesis:**	CR 03
04	**Structural elucidation of organic and complex organics:** By advanced spectral techniques viz., CMR, DEPT, INEPT, Inadequate, APT, COSY, NOESY, HMBC, LCMS and HRMS	CR 04

05	**Biological activity evaluation and computational studies.**	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Reference Books			
RES136-R01	Organic Synthesis – M. B. Smith	-	-
RES136-R02	Stereochemistry of organic chemistry – E. L. Eliel / Samuel H. Wilen	-	-

RES 137: Inorganic Chemistry

Programme Information

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: **http://ycmou.digitaluniversity.ac.in** and **http://www.ycmou.ac.in/**
2	School	School of Architecture, Science and Technology (AST)
3	Discipline	Chemistry
4	Level	Research
5	Course Used in	R91: Ph.D. (Chemistry)

Course Information

Sem	Code	Course Name	CP	CA	EE	TM	Type
01	RES137	Inorganic Chemistry	4	50	50	100	T

Presumed Knowledge and Learning Objectives

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have: • Successfully completed Post-Graduate Degree programme and • PhD Entrance Test	After successful completion of this course, student should be able to: • Explain investigation methodologies in chemistry; • Develop independent investigation that meet the requirements imposed by international academic standards; • Develop a significant number of original research projects that have provided contributions to the growing knowledge in chemistry, and which can be published in national and international refereed scientific publications; • Perform critical analysis, to evaluate and to synthesize new and complex ideas; • Communicate the results of their work to other geologists, academic community and society;

	• Promote the technologic, scientific, social and cultural progress.

UNITS

UN	Name of the Unit	CSs
01	Theoretical concepts of MOT and VBT	CR 01 CSs 3hrs
02	Basic Concepts of organometallic Compounds	CR 02 CSs 3hrs
03	Inorganic Catalytic materials	CR 03 CSs 3hrs
04 05	Fundamentals of solid state materials Basic Concepts and principles of supramolecular chemistry	CR 04 CSs 3hrs

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CP
01	**Theoretical concepts of MOT and VBT :** Concept of hybridizations, structural identification of poly atomic molecules, metal complexes ; HOMO- LUMO concepts , Donor acceptor Chemistry of chemical adducts, Designing and synthesis of N,O, S and P Ligands and macro cyclic ligands, Natural macro cycles and metal complexes, Molecular interactions in liquid –liquid and solid liquid mixtures.	CR 01
02	**Basic Concepts of organometallic Compounds :** Classifications, captivity, metal locene, nature of bonding and their reactivities, Stoichiometric and catalyst reagents, organometallic compounds as a homogeneous catalyst, C-H bond activations, hydrogenation and hydro formylation of alkenes, water gas shift reaction, Monsanto process from acetic acid synthesis and metathesis.	CR 02

03	**Inorganic Catalytic materials :** Classification, Bronsted and Lewis concept of acidity, Heterogeneous catalysts, General synthetic methods, factor affecting on the morphology of catalysts, structural aspects of catalyst, identification of reactive sites, Mechanism of heterogeneous catalytic reactions, FTIR, TPD, TPR, BET surface area analysis. Applications: organic transformation, detoxification hazardous gases molecules, photo reactive oxides, principles of photolysis.	**CR 03**
04	**Fundamentals of solid state materials:** Band theory of solids, stoichiometric and non-stoichiometric defects, Introduction on nanomaterials, classifications, synthetic methodology for inorganic nanomaterials, nanocomposites, factors affecting the crystal growth. Band gap and reactivity. Determination of band gap of nanomaterials, Development of thin film, Basic principles and applications of XRO, EDS, XPS, TEM techniques, Applications of nanomaterials.	**CR 04**
05	**Basic Concepts and principles of supramolecular chemistry:** Molecular recognition, spherical and tetrahedral recognitions, anionic and cationic receptors, supramolecular catalyzed reactions, Natural and artificial molecular assemblies, supramolecular devices	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Reference Books			
RES137-R01	Concepts and models of inorganic chemistry – B.E. Douglas and DM Daniel	-	Oxford & IBH Pub. Co.
RES137-R02	Inorganic chemistry – Gary L Miessler, Donald A Tarr – 3rd edition	-	-

RES 138: Physical Chemistry

Programme Information

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: **http://ycmou.digitaluniversity.ac.in** and **http://www.ycmou.ac.in/**
2	School	School of Architecture, Science and Technology (AST)
3	Discipline	Chemistry
4	Level	Research
5	Course Used in	R91: Ph.D. (Chemistry)

Course Information

Sem	Code	Course Name	CP	CA	EE	TM	Type
01	RES138	Physical Chemistry	4	50	50	100	T

Presumed Knowledge and Learning Objectives

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have: • Successfully completed Post-Graduate Degree programme and • PhD Entrance Test	After successful completion of this course, student should be able to: • Explain investigation methodologies in chemistry; • Develop independent investigation that meet the requirements imposed by international academic standards; • Develop a significant number of original research projects that have provided contributions to the growing knowledge in chemistry, and which can be published in national and international refereed scientific publications; • Perform critical analysis, to evaluate and to synthesize new and complex ideas; • Communicate the results of their work to other geologists, academic community and society;

	• Promote the technologic, scientific, social and cultural progress.

UNITS

UN	Name of the Unit	CSs
01	Theoretical concepts of MOT and VBT	CR 01 CSs 3hrs
02	Basic Concepts of organometallic Compounds	CR 02 CSs 3hrs
03	Inorganic Catalytic materials	CR 03 CSs 3hrs
04 05	Fundamentals of solid state materials Basic Concepts and principles of supramolecular chemistry	CR 04 CSs 3hrs

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CP
01	**Advances in material Chemistry:** Synthesis, structural characterization and applications of coordination complexes, Biological activities complexes. Synthesis of nanomaterials by different methods, their characterization by using various techniques. Applications of nanomaterials.	CR 01
02	**Advances in chemical kinetics:** Mechanics of chemical reactions, electron transfer and proton transfer reactions, complex reaction. Experimental methods for the study of chemical kinetics, effects of various factors on rate of reactions. Homogeneous and heterogeneous catalysis. Mechanism of catalysis, general methods for the preparation of catalysts, action of catalysts, catalysts characterization.	CR 02

03	**Chemical Thermodynamics:** Fundamentals of interaction of liquid-liquid and solid-liquid systems, Density, viscosity , surface tension, refractive index and ultrasonic velocity of aqueous, non-aqueous solutions and their mixtures, excess thermodynamic properties and conductance electrolytes.	**CR 03**
04	**Advances in Electrochemistry:** Electrode position, metal deposition mechanism, factors affecting cathodic deposition of metals, preparation of thin films and nanomaterials, cyclic voltammetry, paleography.	
05	**Surface and Colloidal Chemistry:** Adsorption by solid, applications of adsorption, factors influencing adsorption, adsorption isotherms. Determination of surface area of adsorbent, colloidal systems, classifications of colloids, general properties of colloids, Electrical properties of colloids, electro kinetic properties , determination of size of colloidal particles,, surfactants , micelles.	**CR 04**

Learning Resource Details

LR Code	Title Author	Edition Year	ISBN Publisher
Reference Books			
RES138-R01	Solid state chemistry and applications – A R West	-	Jhon Wieley and sons
RES138-R02	Chemical kinetics – e.S. Laidler	-	Pearson Education

RES 139: ANALYTICAL CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: **http://ycmou.digitaluniversity.ac.in** and **http://www.ycmou.ac.in/**
2	School	School of Architecture, Science and Technology (AST)
3	Discipline	Chemistry
4	Level	Research
5	Course Used in	R91: Ph.D. (Chemistry)

COURSE INFORMATION

Sem	Code	Course Name	CP	CA	EE	TM	Type
01	RES139	Analytical Chemistry	4	50	50	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have: • Successfully completed Post-Graduate Degree programme and • PhD Entrance Test	After successful completion of this course, student should be able to: • Explain investigation methodologies in chemistry; • Develop independent investigation that meet the requirements imposed by international academic standards; • Develop a significant number of original research projects that have provided contributions to the growing knowledge in chemistry, and which can be published in national and international refereed scientific publications; • Perform critical analysis, to evaluate and to synthesize new and complex ideas; • Communicate the results of their work to other geologists, academic community and society;

	• Promote the technologic, scientific, social and cultural progress.

UNITS

UN	Name of the Unit	CSs
01 02 03		CR 01 CSs 3hrs
04 05 06		CR 02 CSs 3hrs
07 08 09		CR 03 CSs 3hrs
10 11 12		CR 04 CSs 3hrs

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CP
01		CR 01
02		
03		
04		CR 02
05		
06		

07		CR 03
08		
09		
10		CR 04
11		
12		

Learning Resource Details

LR Code	Title Author	Edition Year	ISBN Publisher
Reference Books			
RES139-R01			
RES139-R02			