Faculty of Study	Course Code	Course Title
Chemical Sciences	AcSIR-35-CS-AD-001	Basic and Applied electrochemistry
Chemical Sciences	AcSIR-35-CS-AD-002	Materials for Radiation Shielding Applications
Chemical Sciences	AcSIR-35-CS-AD-003	Nanostructured materials for Biosensor techniques
Chemical Sciences	AcSIR-35-CS-AD-004	Environmental chemistry
Chemical Sciences	AcSIR-35-CS-AD-005	Green Chemistry
Chemical Sciences	AcSIR-35-CS-AD-006	Ground Water, Geochemical Studies and Water Resources Management
Chemical Sciences	AcSIR-35-CS-AD-007	Materials Characterisation
Chemical Sciences	AcSIR-35-CS-AD-008	Materials for Biomedical Application
Chemical Sciences	AcSIR-35-CS-AD-009	Environmental Sciences and Management
Engineering Sciences	AcSIR-35-ES-AD-001	Powder Metallurgy
Engineering Sciences	AcSIR-35-ES-AD-002	Advanced Polymeric Materials
Engineering Sciences	AcSIR-35-ES-AD-003	Composite Science and Engineering
Engineering Sciences	AcSIR-35-ES-AD-004	Functional and Smart Materials
Engineering Sciences	AcSIR-35-ES-AD-005	Cellular Materials
Engineering Sciences	AcSIR-35-ES-AD-006	Analysis of Metal Forming Processes

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

Faculty of Study	Course Code	Course Title
Engineering Sciences	AcSIR-35-ES-AD-007	Fatigue and Fracture Evaluation of Materials
Engineering Sciences	AcSIR-35-ES-AD-008	Fiber Reinforced Polymer Composites
Engineering Sciences	AcSIR-35-ES-AD-009	Waste Utilization and Value Addition
Engineering Sciences	AcSIR-35-ES-AD-010	Advanced Geopolymeric and Radiation Shielding Materials
Physical Sciences	AcSIR-35-PS-AD-001	Physics of Thin Films
Physical Sciences	AcSIR-35-PS-AD-002	Crystallography and Diffraction
Physical Sciences	AcSIR-35-PS-AD-003	Materials for Radiation Shielding Applications
Physical Sciences	AcSIR-35-PS-AD-004	Organic Semiconductors
Physical Sciences	AcSIR-35-PS-AD-005	Composite Materials
Physical Sciences	AcSIR-35-PS-AD-006	Advanced Material Characterisation Techniques
Physical Sciences	AcSIR-35-PS-AD-007	Physics and Engineering of Sensor/Energy
Physical Sciences	AcSIR-35-PS-AD-008	Physics and Engineering of Soft Materials

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Basic and Applied electrochemistry**	Course Code	Credits
	AcSIR-35-CS-AD-001	**3**

Basic electrochemistry concepts, Reference electrodes, Electrochemical Thermodynamics, Kinetics of electron transfer, the Taft equation, Diffusion, Double Layers, electrode Kinetics, the Gibbs adsorption isotherm, the Lippmann equation, infinitely dilute solutions and thermal balance, Electro capillary phenomena, Faradaic vs. capacitive currents, transport properties, potential theory.Electrode kinetics and electrochemical techniques: polarizable and non-polarizable interfaces; current potential relationship; methods of measurement of kinetic parameters; over potential; symmetry factor and transfer coefficient; potentiodynamic, mechanistic criteria; diffusion, activation phenomena. Steady state and potential step techniques; polarography; Classifications ofelectrochemical techniques (Cyclic Voltammetry (CV); Square Wave Voltammetry (SWV), Differential Pulse Voltammetry (DPV), Chrono-techniques; convective diffusion systems: RDE, RRDE, microelectrodes, Electrochemical Impedance Spectroscopy (EIS) - concepts and applications, Spectro-electrochemistry and its applications.

Applied topics: fundamentals of batteries: primary, secondary, reserve batteries; solid state and molten solvent-batteries; fuel cells. Photo-electrochemical solar cells and conversion of solar energy. Corrosion – fundamentals and applications, Electrolysis methods, Electrochemistry of polymers and inorganic solids, basics of Electro-polymerization, Electrophoretic deposition and Electroplating.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Materials for Radiation Shielding Applications**	Course Code	Credits
	AcSIR-35-CS-AD-002	**3**

Basics of Radiations: Radiations and its interaction with matter, Importance and Harmful effects of radiations, Types and difference between different types of radiations - X-ray, U.V rays, gamma ray, neutron, microwave, radiowave, alpha & beta particles. Principle and mechanis m of radiation shielding, Radiation shielding materials.

Chemistry of radiation shielding materials: Role and importance of chemicals and processes for making advanced radiation shielding materials, Importance of nanomaterials and waste by products in radiation shielding material. Different types of radiation shielding materials, Characterization of radiation shielding materials and their applications spectrum.

Engineering of radiation shielding materials: Scientific basis for the understanding and development of red mud based synthetic heavy density radiation shielding aggregates, Engineering properties test for synthetic heavy density radiation shielding aggregates, binder material and concrete, Development of Mix design for different grads of radiation shielding concrete. Radiation attenuation test for radiation shielding concrete. Salient advanced features of synthetic shielding aggregate based radiation shielding concrete. Durability test for advanced radiation shielding concrete. Application spectrum of radiation shielding concrete.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title:	Nanostructured materials for Biosensor techniques	Course Code	Credits
		AcSIR-35-CS-AD-003	3

Basic concept and Definition of Biosensors, Introduction of biosensors, Background and history of biosensor, classification of biosensors, types of biological recognition, types of transducers, Principles and transduction approaches, Immobilizationtechniques, chemistry of immobilization, Enzyme electrode reactions, basic characteristics of biosensor (Linearity, sensitivity, selectivity, response time, Km value, enzyme activity, binding affinity), biomarkers, Implications of aptamers and peptide nucleic acid (PNA) in biosensor development.

Potential materials/ Nanostructured materials for biosensors, carbon & 2D based material for biosensors, nanotechnology application in diagnostics, electrochemical/ fluorescence/ ramantechniques based biosensor, Microfluidic ("Lab-on-Chip") devices, Micro-fabrication, Microfluidics for miniaturizations, Electro-analytical techniques in clinical chemistry, Multiplex system-based biosensor, Examples and commercial applications of biosensor devices, Commercial lab-on-chip biosensor systems, Future of biosensor devices.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Environmental chemistry**	Course Code	Credits
	AcSIR-35-CS-AD-004	**3**

Environmental analysis & parameters - air, noise, water, and soil pollution. Introduction to industrial wastes, their definition, classification, sources and characteristics. Environmental impact & risk assessment, ambient air quality monitoring & modelling, industrial disaster modelling, its regulations and framework. Air pollutants, their sources and types, air pollution control devices .Global warming, green house gases and their capture.

Water: properties; acid-base reactions, electrochemistry, pH; Eh; Chemical methods in treating water and wastewater; water disinfection.. Soil chemistry: nature and importance; acid-base and ionexchange reactions in soils; colloidal chemistry of inorganic constituents, clays, organic matter and soil humus; adsorption desorption reactions, ion exchange, degradation of pesticides and hazardous substances in soil.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Green Chemistry**	Course Code	Credits
	AcSIR-35-CS-AD-005	**3**

Green chemistry concepts: Basics of inorganic, organic, physical and biochemistry, Nomenclature (IUPAC), molarity, molality andnormality, types of bonding, Ionic, covalent and non-bonding interactions, Acids and bases, Atomic structure, periodic table and periodic properties, stoichiometry, chemical reactions and kinetics, solvent effects, functional groups in organic compounds, scope and interdisciplinary nature of green chemistry; Environmental factors; Industrial applications of green chemistry, Energy efficiency and atom economy, Catalysis and green chemistry, Alternate reaction media and reaction systems, ionic liquids, Waste reduction at source.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title:	Course Code	Credits
Ground Water, Geochemical Studies and Water Resources Management	**AcSIR-35-CS-AD-006**	**3**

Classification of rocks with respect to water bearing characteristics, geological structures favouring groundwater occurrence, geomorphic units and their influence on occurrence and movement of water resources, hydrological properties of rocks, aquifer and its classification, surface and subsurface water sources, hydrological cycle, Darcy's law, groundwater movement, water table, aquifer test, draw down, flow nets, geomorphic processes and land forms, definition and importance of structural geology with re ference to water resources management, groundwater exploration, geochemical studies, chemical parameters of water

Recharge mechanisms, groundwater recharging techniques for rejuvenation of water resources, watershed development and management, water resources mapping, monitoring and management, water resources contamination, groundwater modelling (procedures, software, applications of modflow, SWAT, GMS, AGPNS, rockworks etc, long term prediction of the effect of future groundwater withdrawals on groundwater levels and contaminants transport movement.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Materials Characterisation**	Course Code	Credits
	AcSIR-35-CS-AD-007	**3**

Basic concept, SI units, design of experiments, error and standard deviation, Introduction to materials properties; physical, mechanical, thermal, electrochemical, tribological, rheological, interfacial, magnetic and electrical properties.

Introduction to different microscopy techniques, Resolution, magnification, depth of field, depth of focus, Imaging - theory and concepts.

X-ray microanalysis: EDS, WDS, EPMA (Surface analysis), XRD, EBSD, TEM (Applications to crystallography), X-ray methods (EDS, WDS, XRF, XANES, XPS, EXAFS),Scanning force microscopy (AFM), Spectroscopy (IR, Raman),Thermal techniques; thermal gravimetric analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC) and Differential Mechanical Analysis (DMA).Sample preparation for different characterisations.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Materials for Biomedical Application**	Course Code	Credits
	AcSIR-35-CS-AD-008	**3**

Biomaterials and Biomimetic materials: Concept of biomaterials and biomimetic materials, Types of biomaterials (polymers, ceramics, metals, composites), Interactions between cells and surface of biomaterials, Modification of biomaterials surface, Concept of biocompatibility and biodegradability, 3D printing of biomaterials, Electrospinning technique for nanostructuring of biomaterials, Concept of hydrogels, Biomedical applications of biomaterials including implants, drug delivery, tissue engineering, wound care management etc.

Antimicrobial materials and Coatings: Antimicrobial agents (antibiotics, metal ion/metal nanoparticles, antimicrobial peptides, antimicrobial polymers), Antimicrobial materials, application of antimicrobial materials in food packaging, textiles, paints and varnishes, implantable devices, drug delivery, self-cleaning surfaces, wound dressings. Antimicrobial hydrogels and their applications, Antimicrobial phytochemicals, Antimicrobial Coatings, Methods to develop antimicrobial coatings, Antimicrobial coatings for medical devices, surgical equipment and high touch surface like doors, glass etc.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Chemical Sciences** **Total Credits 6**

Title: **Environmental Sciences and Management**	Course Code	Credits
	AcSIR-35-CS-AD-009	**3**

Air: Air pollutants, their sources and types, global warming, green house gases and their capture, air quality monitoring, air pollution control devices. Environmental analysis & parameters - air, noise, water, and soil pollution. Environmental impact & risk assessment, ambient air quality monitoring & modelling, industrial disaster modelling, its regulations and framework.

Water: properties; acid-base reactions, electrochemistry, pH; Eh; Chemical methods in treating water and wastewater; water disinfection. Removal of water pollutants (different processes/ methods of removal of toxic/ heavy metals, impure water/ effluent treatment using different separation techniques, packed bed towers / columns), adsorbents (commercial adsorbents and their application, role of industrial wastes in synthesis and characterization of cost-effective adsorbents, their application for effluent treatment, water purification)

Industrial effluents, their types, sources, measurement and characteristics, environmental pollution monitoring and control – DO, BOD, COD

Assesment and monitoring: Concept and significance, environmental impact studies, rules and acts, water and air pollution (effluents, groundwater contamination, air pollutants, global warming, estimation/modeling & prevention), air and water quality monitoring and modeling, scope of error and precautions, air pollution control devices, industrial effluents and treatments, environmental issues.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Powder Metallurgy**	Course Code	Credits
	AcSIR-35-ES-AD-001	**2**

Basic principles and concept, processing steps and techniques, powder production and characterization, mechanical alloying, stages of sintering, driving forces for sintering, mechanism of sintering, solid state and liquid phase sintering, reaction sintering, sintering furnaces (conventional, microwave, SPS etc.) and atmospheres, hot pressing, cold and hot isostatic pressing, self propagating combustion sintering, specialized characterization techniques and standards, parameters controlling properties, sintered products (iron, copper titanium and aluminium base materials/products, MMCs, metal foam, functional materials), sintered product property evaluation and standardization.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Advanced Polymeric Materials**	Course Code	Credits
	AcSIR-35-ES-AD-002	**2**

Concept of nanofillers and polymer nanocomposites, polymer nanocomposites (types, synthesis, characterization, characteristics and applications), functional polymers (synthesis and characterization), introduction of inorganic nanoparticles into functional polymers, surface modification techniques, functionalization of the surface of nanoparticles, shape memory polymers, conducting polymers, magnetic polymers, role of polymers in high-tech areas such as light emitting diode, OSR insatellite communication, photovoltaic etc., polymers for insulation and electronics, laminates and sandwich panels, characterizat ion of some important thermoplastics and thermosets, rheological behaviour, interpretation of information and application potential, liquid crystalline polymers (properties and applications), self reinforced composites. polymer blends and alloys, theories of polymer miscibility, various commercial blends and their applications, reactive blending

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Composite Science and Engineering**	Course Code	Credits
	AcSIR-35-ES-AD-003	**2**

Concept of Composite materials, Micromechanics of composites, Rule of mixture, Various types of composites, Classification based on Matrix Material, Classification based on reinforcements, Reinforcements/Fibres, Types of fibres, Whiskers and Flakes, Mechanical properties of reinforcements, Synthesising techniques, Processing of Advanced composites, Casting, Liquid Metal Infiltration, Solid State diffusion, Liquid phase sintering, Metal matrix composites, Carbon composites, Polymer matrix composites, Ceramic Matrix Composites, Natural/Bio composites, Functionally graded composites, , Hybrid composites, Processing and characteristics of nanocomposites.

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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Functional and Smart Materials**	Course Code	Credits
	AcSIR-35-ES-AD-004	**2**

Basic concept and approach, stimuli, shape memory effect, response to thermal, magnetic, electrical, piezoelectric, and others effects, creation of functional and smart materials with preset properties, generation of shape memory effect, structure, phase transformation and properties, specific property characterization, interpretation of information, smart materials (shape memory alloys and polymers, piezoelectric, magnetostrictive, pH-sensitive, halochromic, chromogenic, surface active & biomimitic materials, ferrofluids, electro and magneto rheological material etc.), material development, application potential (energy sector, information technology, health, lab-on-a-chip etc.), principles of ferrofluids, synthesis, characterization, properties and applications.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Cellular Materials**	Course Code	Credits
	AcSIR-35-ES-AD-005	**2**

Definition and classification, concepts and design, general characteristics, applicable constitutive laws and equations, foam and foaming, chemistry & physical formation, foaming ingredients, factors controlling cell fraction and morphology, types (metallic, ceramic & polymeric, open cell, closed cell, syntactic etc.), selection criteria, properties, synthesizing techniques, (liquid metallurgy, powder metallurgy and others), characterization, property controlling parameters, application potential (noise attenuation, energy absorption, damping, packaging, thermal insulation, heat exchanger, Honey comb structures, foam core sandwich panels, biomedical implants, electromagnetic shielding, hydrogen storage, fuel cells etc.)

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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Analysis of Metal Forming Processes**	Course Code	Credits
	AcSIR-35-ES-AD-006	**2**

Stress-strain relations in elastic and plastic deformation, yield criteria for ductile metals, work hardening and anisotropy in yielding, flow curves, elements of theory of plasticity, formulation of plastic deformation problems, application of theory of plasticity for solving metal forming, problems, effect of temperature and strain rate in metal working processes, effects of friction and lubrication in cold and hot working, fundamentals, and analysis of important forming processes- forging, rolling, wire drawing, extrusion, sheet metal forming processes like deep drawing, stretch forming, bending, introduction to finite element simulation of forming processes.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Fatigue and Fracture Evaluation of Materials**	Course Code	Credits
	AcSIR-35-ES-AD-007	**2**

Fatigue, high cycle fatigue, low cycle fatigue, constant amplitude fatigue cycle, variable amplitude fatigue cycle, Overview of conventional stress, strain and energy based life approaches, cyclic stress stain curve, fatigue crack initiation and crack growth analysis, Paris equation. Introduction to fracture mechanics, different modes of fracture, Griffith criteria, linear elastic fracture mechanics, , elastic-plastic fracture mechanics, Stress concentration factor, Stress intensity factor (K), crack tip opening displacement (CTOD), j-integral, threshold stress intensity factor, fracture toughness, stretch zone width (SZW), application of finite element method in fatigue and fracture evaluation.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Fiber Reinforced Polymer Composites**	Course Code	Credits
	AcSIR-35-ES-AD-008	**2**

Introduction to polymeric composite materials, reinforcing materials (fibres, natural fibres whiskers and particles), glass fibres, fibre reinforced plastics, polymer based composite materials (comparison of different materials with composites, hybrid and sandwich type composites, principles of composite reinforcement, effect of fibrous reinforcement on properties, types of reinforcement such as natural, glasses, carbon/graphite, aramid fibres, high strength and high modulus fibers), surface treatment and various forms of fibres, thermosetting and thermoplastic materials for the composites and their selection for a particular application, processing and production techniques like hand-layup, bag moulding, filament winding and pultrusion prepegs, their manufacture and characterization. sheet moulding and dough moulding compounds and their processing, preform and resin transfer mouldings.
Introduction to natural fibres, extraction of sisal fibres, grading of sisal fibres, physical properties of sisal fibres, types of jute fibres, jute and sisal fibre properties, jute fibre polymer composite development, sisal fibre polymer composite development.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Waste Utilization and Value Addition**	Course Code	Credits
	AcSIR-35-ES-AD-009	**2**

Industrial wastes (red mud, fly ash, slag, low grade minerals, stone dust etc.), different category of wastes,their source of generation and their methods of handling, environmental impact, audit, acts and regulations, global policy, regulation, waste management, municipal solid wastes, management and disposal, processes/ methods of waste utilization for different environmental applications such as decontamination of ground water, recycling, solidification/ stabilisation, immobilisation, detoxification, vitrification of toxic waste, management of hazardous and toxic waste, natural products, renewable resources, biodegradable polymers, conversion of wastes into value added materials, application potential (land use planning by reclamation of wastelands, overburden areas/mine spoil dumps, ash-back haulregions, etc for agriculture, horticulture, forestry, and other useful purposes, agriculture, construction, transportation, general engineering etc.) Introduction to industrial wastes, types, sources and characteristics, different rules and acts, classification of hazardous waste, its characteristics, waste recycle & reuse, solidification and stabilisation, waste to material approach using industrial waste, disposal of industrial wastes, chemistry of silica and silicon, ceramic, geopolymers and their applications, theory and principles of synthesis, characterization and applications of radiation shielding materials

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Engineering Sciences** **Total Credits 6**

Title: **Advanced Geopolymeric and Radiation Shielding Materials**	Course Code	Credits
	AcSIR-35-ES-AD-010	**3**

Advanced Geopolymeric Materials :

Introduction to geopolymers, basics of cement, comparison of geopolymers and cement, chemistry of geopolymers, terminology, types of geopolymers, hybrid inorganic organic geopolymers, lingo-silico-aluminous materials, cellulose, hemicellulose and lignin, difference between geopolymers and organic polymers, conceptual model for geopolymerisation, preparation of geopolymers by conventional and advanced process, comparison of geopolymers prepared by conventional and advanced process, characterization of geopolymers, factors affecting geopolymerisation, application of geopolymers, role of Si-Al ratio in formation of geopolymers and their application, Egypt pyramids. Chemical durability of geopolymers. Engineering of Geopolymers: Scientific basis for the understanding and development of construction materials, Advanced Geopolymeric mortar and Concrete, Engineering properties tests for aggregates, binder material and geopolymer mortar and concrete, Durability test for geopolymer concrete. Modern concrete construction practices. Development of Mix design for different grades of geopolymer concrete. Ligno-Silico-Aluminous based superplastisizer for geopolymer concrete. Salient advanced features of geopolymer concrete. Raw Materials used in formation of geopolymers: Sea water and sea sand, conventional coarse and fine aggregates, fly ash, metakaolin, red mud, blast furnace slag ,copper mine tailings, brine sludge and other industrial wastes. Applications of geopolymeric materials: Construction,coating, prefabricated materials, aviation, radiation shielding, high temperature applications drug delivery waste water
treatment, Advanced Radiation Shielding Materiala.

Basics of Radiations : Radiations and its interaction with matter, Importance and Harmful effects of radiations, Types and difference between different types of radiations- X-ray, U.V rays, gamma ray, neutron, microwave, radio wave, alpha & beta particles. Principle and mechanism of radiation shielding, Engineering of radiation shielding materials: Scientific basis for the understanding and development of red mud based synthetic heavy density radiation shielding aggregates, Engineering properties test for synthetic heavy density radiation shielding aggregates, binder material and concrete, Development of Mix design for different grads of radiation shielding concrete and other building materials. Radiation attenuation test for radiation shielding Materials. Application spectrum of radiation shielding Materials.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Physics of Thin Films**	Course Code	Credits
	AcSIR-35-PS-AD-001	**2**

Thin films-introduction: Thin films and their importance, Physical and chemical vapour deposition, Sputter coating, DC and RF sputtering, Magnetron sputtering, Ion beam sputtering, Pulsed laser ablation, Plasma enhanced chemical vapour deposition, Vacuum arc, Chemical vapour deposition (CVD), Relationships between deposition parameters and film properties, Applications of thin films.
Physics of thin films: Steps in thin film growth, Thin film growth models and growth modes, Nucleation and growth, Coalescence processes. Epitaxial growth, Vacuum requirements for film growth, Effect of stress, Applications and emerging technologies.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Crystallography and Diffraction**	Course Code	Credits
	AcSIR-35-PS-AD-002	**2**

Symmetry and periodicity of crystals, Bravais lattices, Point groups and space groups, Miller indices, Reciprocal lattice, Scattering factor, Stereographic projection, Basics of X-rays, Production and detection of X-rays, X-ray diffraction, X-ray diffraction methods, Diffractometer measurements, Determination of crystal structure, Precise lattice parameter determination, Qualitative phase analysis, Quantitative phase analysis, Crystallite size and residual strain analysis by X-rays, Texture determination by X-rays.

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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Materials for Radiation Shielding Applications**	Course Code	Credits
	AcSIR-35-PS-AD-003	**2**

Radiations: Radiations and its interaction with matter, Importance and harmful effects of radiations, Types and difference between different types of adiations: X-ray, U.V rays, Gamma ray, Neutron, Microwave, Radiowave, Alpha & Beta particles. Principle and mechanism of radiation shielding, Radiation shielding materials.

Chemistry of radiation shielding materials: Role and importance of chemicals and processes for making advanced radiation shielding materials, Importance of nanomaterials and waste by products in radiation shielding material. Different types of radiation shielding materials, Characterization of radiation shielding materials and their applications spectrum.

Engineering of radiation shielding materials: Scientific basis for understanding and development of red mud based synthetic heavy density radiation shielding aggregates, Engineering properties test for synthetic heavy density radiation shielding aggregates, binder material and concrete, Development of mix design for different grads of radiation shielding concrete, Radiation attenuation test for radiation shielding concrete.

Salient advanced features of synthetic shielding aggregate based radiation shielding concrete, Durability test for advanced radiation shielding concrete. Application spectrum of radiation shielding concrete.

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AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Organic Semiconductors**	Course Code	Credits
	AcSIR-35-PS-AD-004	**2**

Organic semiconductors: General features, Physics of Organic semiconductors, Optical properties, Electrical properties: Injection and transport, Structural properties, Structure property relationship, Basic ideas of doping fabrication processes, Thermal evaporation, Vapor phase deposition, Solution processing: Spincoating, Dipcoating, Doctor blade, Layer by layer, Langmuir -Blodgett technique, Organic single crystals, Device fabrication, Major devices and characterizations,
OLED: External quantum efficiency, Current efficiency, Power efficiency, Chromaticity, lifetime,
OSC: Power conversion efficiency, Fill factor, IPCE,
OTFT: Estimation of mobility, Contact resistance, Subthreshold swing,
Memory Devices: Capacitive, Resistive and FET type memories, Sensors, Optical and electrical improving performance of devices: Guidelines for substrate preparation, Interface modification, Post-fabrication treatment, Purification of materials, Encapsulation, Outcoupling in OLEDs, Light concentrators in solar cells.

Reommended at the 4th meeting of Board of Studies, AcSIR on Sep 7, 2020.
Approved at the 27th meeting of Senate, AcSIR on Sep 10, 2020

AcSIR Academic Centre Code: 35

CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Composite Materials**	Course Code	Credits
	AcSIR-35-PS-AD-005	**2**

Concept of composite materials, Various types of composites, Classification based on matrix material, Classification based on reinforcements: Reinforcements/fibers ,Types of fibres, Whiskers and flakes, Mechanical properties of fibres, Metal matrix composites, Processing of advanced composites, Casting, Solid state diffusion, Liquid metal infiltration, Liquid phase sintering, Carbon composites, Polymer matrix composites, Processing and characteristics of nanocomposites, Hybrid composites, Ceramic matrix composites, Natural/bio composites.

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CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Advanced Material Characterisation Techniques**	Course Code	Credits
	AcSIR-35-PS-AD-006	**2**

Introduction to different microscopy techniques, Resolution, magnification, Depth of field, Depth of focus, Imaging: Theory and concepts,
X-ray microanalysis: Surface analysis techniques, Crystallographic techniques, X-ray methods, Scanning probe microscopy, vibrational spectroscopy, Thermal analysis, Sample preparation for different characterisations.

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CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Physics and Engineering of Sensor/Energy**	Course Code	Credits
	AcSIR-35-PS-AD-007	**2**

Fundamentals of sensors and networked sensor systems with special emphasis on sensor-fabrication. Smart materials and devices, Physics of low dimensions devices, Electrochemical sensors, Optical sensors, Piezoelectric sensors, Humidity sensors, Field effect transistor, Micro and nanofabrication technologies and characterization techniques, Sensors modelling and simulation, Nanophotonics, Science and technologies of semiconductor, Integrated chip to system design, Micro/nanofluidics and sensor, Flexible sensors, Quantum dots based sensors, Micromachining, 3D Printing in sensors, Nanorod-sensor probes, Magnetic particles, Sensor probes, Nanowires-FET sensing system, Micro electro-mechanical systems (MEMS), Nanomachines, Advanced carbon nanotube/graphene structures for sensing applications.

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CSIR-Advanced Materials and Processes Research Institute **CSIR-AMPRI**

Course 3 : Advanced Course **Physical Sciences** **Total Credits 6**

Title: **Physics and Engineering of Soft Materials**	Course Code	Credits
	AcSIR-35-PS-AD-008	**2**

Introduction to soft materials, types, structure and properties of soft materials, Synthesis methods and analysis, Chemical exfoliation of layeredmaterials, Liquid crystals, Graphene oxide liquid crystals structure, Defects and applications, Rheology of soft materials,
Layered material composites: Thin film, Foam and segregated structures, Fabrication and applications.

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