

Chhattisgarh Swami Vivekanand Technical University, Bilai (C.G.)			
Name of program	: Bachelor of Technology	Semester	: V
Branch	: Plastics Engineering	Code	: C095511(095)
Subject	: Plastic Materials -I	Tutorial Periods	: 1 per week
Theory Periods	: 3 per week	Assignments	: Two (minimum)
Class Tests	: Two (minimum)	Maximum Marks	: 100
Exam. Duration	: Three Hours	Minimum Marks	: 35

Course Objectives

- To enable the students to learn about the general methods of preparation of an individual class of plastic materials.
- To study the general properties, processing behavior and applications of the different class of plastic materials
- To understand the structure-property relation of the different classes of plastic Materials.

Unit -I

Introduction to Polymer Chemistry, Sources of plastics raw materials, Monomers, Polymers, Polymerisation, Types of Polymerisation, Classification. Definition and Classification of Plastics, General properties, Historical development of plastic industry, future trends, Thermoplastics, Thermosetting, Engineering & High-performance plastics. Natural Polymers - Shellac resin and natural rubber.

UNIT II

Introduction, Sources and manufacture of plastics raw materials, basic chemistry, Methods of manufacture, Flow behaviour, General properties and applications of Polyolefin, Polyethylene, Polypropylene, Homopolymers, Copolymers.

Unit -III

Introduction, Sources and manufacture of plastics raw materials, basic chemistry, Methods of manufacture, Flow behaviour, General properties and applications of Polystyrene & Styrene copolymers, Polystyrene, HIPS, ABS etc.

Unit -IV

Introduction, Sources and manufacture of plastics raw materials, basic chemistry, Methods of manufacture, Flow behaviour, General properties and applications of Polyvinyl chloride, Polyvinyl Acetate, Polyvinylidene chloride, Polyvinyl alcohol, PMMA. Cellulose polymers (Cellulose nitrate, cellulose acetate) etc.

Unit -V

Introduction, Sources and manufacture of plastics raw materials, basic chemistry, Methods of manufacture, Flow behaviour, General properties and applications of biodegradable polymer PLA, PCL, PHB, PBAT etc.

Text Books:

1. Polymer Science-V.R. Gowariker
2. Plastic Materials Ed 7 - By Brydson, J.A.
3. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J
4. Trends and Applications in Advanced Polymeric Materials, Sanjay K. Nayak, ,SmitaMohanty .Lakshmi Unnikrishnan., Wiley Publication, 2017
5. Technical Manual on Plastic Materials, Sanjay K Nayak et. al., CIPET Internal publication, April 2007.

Reference Books:

1. Plastics Materials - A. W. Birley
2. Modern Plastics Hand Book- Charles A. Harper

Course outcomes:

Students would be able to know the basic chemistry of polymers, thermoplastics materials and their applications.

Chhattisgarh Swami Vivekanand Technical University, Bilai (C.G.)					
Name of program	:	Bachelor of Technology	Semester	:	V
Branch	:	Plastics Engineering	Code	:	C095512(095)
Subject	:	Plastics Testing Technology -I	Total Tutorial Periods	:	1 per week
Theory Periods	:	3 per week	Assignments	:	Two (minimum)
Class Tests	:	Two (minimum)	Maximum Marks	:	100
Duration	:	Three Hours	Minimum Marks	:	35
Course Objectives					
<ul style="list-style-type: none"> • To provide an understanding of conditioning and test atmosphere. • To understand the concept of humidity on testing • To impart significance and importance of mechanical and thermal testing. • To familiar with the different polymers and their identification 					
UNIT –I					
Consideration of importance of testing for the identification of plastics, Determination of necessary manufacturing conditions, Assessment of properties of finished products with service requirements.					
UNIT-II					
Standard and specifications, National and International standards-BIS, ASTM, ISO & NABL. Test specimen preparation-preconditioning and test atmosphere					
UNIT-III					
Identification of common plastics materials by simple tests e.g., visual inspection, density, effects of heat, combustion and solvents, analysis with common solvents.					
UNIT-IV					
Mechanical Properties: Hardness-tensile strength-compressive strength-shear strength-flexural strength-impact strength-dynamic stress-strain properties-creep-relaxation and Compression set tests, friction and wear-abrasion test-fatigue-burst strength-and folding endurance etc.					
UNIT-V					
Thermal properties: Specific heat and thermal conductivity thermal dependent properties-thermal endurance-glass transition temperature-thermal yield tests, Heat deflection temperature, Vicat softening temperature, Marten's heat resistance test, low-temperature brittle point and flexibility test-coefficient of thermal expansion-shrinkage, Thermal stability, Thermal ageing and flammability etc.					
Text Books:					
<ol style="list-style-type: none"> 1. Fundamentals of plastics testing – by Dr. S. K. Nayak, springer publication 2. How to Identification of Plastics by simple methods CIPET Publication 2002. 3. Hand Book of Plastics Testing Technology by Shah, Vishnu, John Wiley and Sons, SPE Monograph 4. Hand Book of Polymer Testing by Brown; Roger P (Ed.), Marcel Dekker, Inc, New York (1999). 					
Reference Books:					
<ol style="list-style-type: none"> 1. Electrical Properties of Polymers by Blythe; A. R., Cambridge University Press, Cambridge(1979). 2. Testing and Evaluation of plastics – Mathur and Bharadwaj 3. Simple methods for identification of plastics- Dietrich Braun 					
Course outcomes:					
After studying the students would able to know about the identification of plastics materials by simple tests, manufacturing conditions, Standard and specifications, Testing of Mechanical properties, and Thermal properties.					

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Name of program	: Bachelor of Technology	Semester	: V
Branch	: Plastics Engineering	Code	: C095513(095)
Subject	: Plastics Processing Technology-I	Tutorial Periods	: 1 per week
Theory Periods	: 3 per week	Assignments	: Two (minimum)
Class Tests	: Two (minimum)	Maximum Marks	: 100
Exam. Duration	: Three Hours	Minimum Marks	: 35

Course Objectives The students will be able to -

- Understand the basics of plastics processing techniques.
- Learn the fundamentals of compression & transfer moulding, injection moulding, extrusion process and blow process.
- Analyze the troubleshooting in processing techniques.
- Apply basic processing knowledge to solve troubleshooting through process parameter optimization.

Unit – I

Basics of Plastics Processing: Processing methods, the effect of polymer properties, process selection etc. Fluids: classifications of fluids, Newtonian and Non-Newtonian fluids, time-independent and time-dependent fluids, elastic viscous fluids.

UNIT II

Compression Moulding: Introduction-principles-types of Machines, types of moulds. Compression moulding cycle, process variables and their effect on product quality. Common moulding defects, causes and remedies, advantages and disadvantages.

Transfer Moulding: Introduction-principles-Pot type, Plunger type, screw transfer moulding. Common moulding defects, causes and remedies, advantages and disadvantages.

UNIT III

Injection Moulding: Basic principles, Definition of terms, specifications, Types of machines used, parts and their functions. Injection moulding cycle-process variables and their effect on product quality. Types of nozzles, cavity pressure profile. Common moulding defects, causes and remedies. Thermoset injection moulding, Machine description, parts, process parameters.

UNIT IV

Extrusion: Introduction, principles, classification of extruders, single screw extruder, specifications, screw nomenclature. Various extrusion methods and post extrusion systems like sizing, cooling, take-off, cutting etc., as related to film, pipe, sheet, wire and profile extrusions. Troubleshooting in an extrusion line, Twin-screw extruder, principle, types, process merits and demerits. Vented extruders.

UNIT V

Blow Moulding: Introduction, principles, processes, Extrusion blow moulding, Injection blow moulding, stretch blow moulding, blow moulding of large containers, parison programming.

Text Books:

1. Hand Book of Plastic Technology, Volume-1 by Allen; W. S. and Baker; P. N.
2. Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors, New Delhi (2004).
3. Injection Molding Theory & Practice by Rubin, Irvin.
4. Injection Molding Hand Book by Rusato, D.V & Rosato, D.V.
5. Plastic Engineering Hand Book & D – 5 by Society of Plastic Industry.
6. Plastics Material & Processing By Strong, A, Brent, Blow Molding Hand Book By Rosato,

D.V & Rosato, D.V. Plastic Extrusion Technology by Hensen.

7. Plastic Engineering Hand Book By SPI
8. Fundamentals of Plastics Processing (Vol. 1) Injection & Blow Moulding, Sanjay K Nayak , S Sugumar, R T Nagaralli, TMH Publication, Vol. 1, 2014.
9. Technical Manual on Plastic Processing, Sanjay K Nayak et. al., CIPET internal publication, April 2007.

Reference Books:

1. Handbook of Applied Polymer Processing Technology by Cheremisinoff; Nicholas P. and Cheremisinoff; Paul N. (Eds.), Marcel Dekker Inc., New York (1996)
2. A Guide to Injection Molding of Plastics Barbour, P.C.
3. Plastics materials & processing by Brent A. Strong
4. Plastics processing by Danesh Mehta

Course outcomes:

After studying the students would be able to understand and apply the basics of plastics processing techniques.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Name of program	: Bachelor of Technology	Semester	: V
Branch	: Plastics Engineering	Code	: C095514(095)
Subject	: Additives & Compounding	Tutorial Periods	: 1 per week
Theory Periods	: 2 per week	Assignments	: Two (minimum)
Class Tests	: Two (minimum)	Maximum Marks	: 100
Exam. Duration	: Three Hours	Minimum Marks	: 35

Course Objectives

- To know various drawbacks of polymer materials and suitable remedies.
- To provide basic knowledge in selecting the additives to enhance the required performance of polymer
- To impart knowledge on the chemistry and mechanism involved in the incorporation of additives into polymer matrix
- To know the various compounding methodologies for plastics materials and learn the maintenance of compounding machinery

UNIT-I

Types of adhesives, classification, the chemistry of epoxy, acrylic, elastomer modified, PU adhesives, pressure-sensitive adhesives, hot melt adhesives solvent and emulsion-based adhesives formulations of various adhesives health and safety aspects in the adhesives industry.

UNIT-II

Fillers, Antioxidants, Thermal Stabilizers, Lubricants-Plasticizers, Toughening agents Colorants, Fire retardants, Coupling agents, blowing agents, Ultraviolet stabilizer, Antistatic agents, Anti-blocking agents, Slip and ant slip agents, processing aids, mould release agents.

UNIT-III

Compounding, Need for compounding, Selection of polymers and compounding ingredients, general objectives, possibilities and limitation of additives into polymer matrices.

UNIT-IV

Mixing methodologies: Different types of mixing-Dispersive/Distributive, Mixing and mixing equipment like Intensive & Extensive, Mixer, Batch mixer & continuous Mixer, Two Roll Mill, Twin Screw Extruder- Machine construction, specifications, temperature control system, operating characteristics and maintenance of compounding machines.

UNIT-V

Case studies: on the preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys, case studies on the application of blends and alloys. Compounding of PVC, compounding of natural rubber & synthetic rubber

Text Books:

1. Polymer additives –by Muller
2. Plastics additives handbook by Hans Zweifel, Hanser publication
3. Chemistry and Technology of polymer additives by Malaika Golovoy, Marcel Dekker publication

Reference Books:

1. Chemistry and Technology of Polymer Additives by Al – Malaika; S. Golovoy; A and Wilkie (Eds), Black well Science Ltd, Oxford (1999)
2. The Role of Additives in Plastics, Mascia; L., by Edward Arnold Publishers Ltd., U.K. (1974).
3. Additives for Plastics Handbook, 2nd Edition, by Murphy; John, Elsevier Advanced Technology, Oxford.

Course outcomes:

Students will have a clear understanding of various types of additives for plastics and their merits and demerits. They learn about various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Name of program	: Bachelor of Technology	Semester	: V
Branch	: Plastics Engineering	Code	: C095531(095)
Subject	: Fluid Flow Operations (Professional Elective I)	Tutorial Periods	: Nil
Theory Periods	: 2 per week	Assignments	: Two (minimum)
Class Tests	: Two (minimum)	Maximum Marks	: 100
Exam. Duration	: Three Hours	Minimum Marks	: 35

Course Objectives

- To introduce the basic concepts of fluid mechanics and their applications in Chemical Engineering to design the equipment for measurement and transport of fluids in chemical plants and to design the related piping and control systems.
- To develop the ability to determine pressure and velocity variations in the internal and external flow of fluids to identify the basic mechanisms, formulate problems and solve the problems by analysis or by application of experimental data.

UNIT - I

Unit systems, fluids: properties and classification, fluid statics and fluid dynamics, laminar, transition and turbulent flows, applications of fluid flow in chemical engineering., hydrostatic equilibrium, manometers: simple, differential and inclined, properties of manometric liquids, decanter: continuous, gravity and centrifugal.

UNIT-II

Fluid flow phenomena: Newtonian and non-Newtonian fluids, viscosity and momentum flux, laminar & turbulent flow in boundary layers, friction factor chart, friction factor & pressure drop, Bingham pie theorem, Bingham plastic fluid and model, Pseudoplastic fluids.

Flow behavior of polymer melt- polymer melt viscosity and its behaviour in sprue bush runner and during filing of impression, working of polymer pressure in sprue bush and runner, pressure drop calculation during sprue bush and runner, Reynolds number and other dimensionless numbers for polymer, runner size on the base of pressure drop of the polymer melt, pressure calculation for polymer melt to fill the impression on the base of its thickness, cavity pressure calculation etc.

UNIT-III

Material & energy balance, continuity equation, equation of motion, Bernoulli's equation, the flow of incompressible fluids, flow past immersed bodies, packed and fluidized beds, introduction to fluidization, minimum fluidization velocity.

UNIT-IV

Pipes fittings and valves: pipe sizing for the flow of liquids and gasses, joints and fittings, sudden contraction and expansion, classification of valves and pumps and their selection criteria, losses in piping, valves and fittings, the performance of centrifugal pumps, characteristic curves for pumps, NPSH calculation for pumps, fans and blowers used in plastics industries.

UNIT-V

Flow and control devices, control valve, valve characteristics, sizing of control valves, flow measurement using venturi meter, orifice meter, rotameter & pitot tube, weir, v- notches and square notches used in plastics industries.

Text Books:

1. Unit Operations in Chemical Engineering by McCabe W.L., Smith J.C., Hariot P., McGraw Hill International, 7th ed., 2005.
2. Introduction to Chemical Engineering by Badger W.L., Banchero J.T
3. "Chemical Engineering Vol. I – Fluid flow, Heat Transfer and Mass Transfer; Coulson & Richardson's, Butterworth – Heinemann Publication, 6 th Edition.

Reference Book:

1. Fluid Dynamics and Heat Transfer, James G. Knudson and Donald L. Katz, Mc Graw Hill Publication
2. Fluid Flow In Pipes And Channels by Asawa G L , CBS Publication
3. Theory and Applications of Viscous Fluid Flows by Kh. Zeytounian R.

Course outcomes:

Students will have a clear understanding of fluid flow through various types of Pipe and fitting products and flow and control devices used in industries and their operation.

Chhattisgarh Swami Vivekanand Technical University, Bilai (C.G.)

Name of program	:	Bachelor of Technology	Semester	:	V
Branch	:	Plastics Engineering	Code	:	C095532(095)
Subject	:	Polymer Degradation and Stabilization (Professional Elective I)	Tutorial Periods	:	Nil
Theory Periods	:	2 per week	Assignments	:	Two (minimum)
Class Tests	:	Two (minimum)	Maximum Marks	:	100
Exam. Duration	:	Three Hours	Minimum Marks	:	35

Course Objectives

- Understand the thermal degradation of the polymer
- Understand various aspects of mechanical and Ultrasonic degradation
- Acquire knowledge of biodegradation and UV degradation of plastics
- Understand the knowledge about Chemical methods of degradation of polymers

UNIT- I

Introduction and thermal degradation definition, modes of polymer degradation, mechanistic aspects, single-step process and chain reactions, auto-oxidation, random and specific site attack,

UNIT - II

Mechanical degradation and ultrasonic degradation: introduction, mechanistic aspects, degradation studies, polymer degradation in solution. ultrasonic degradation, importance, experimental methods, mechanism of ultrasonic degradation (cavitation and direct effects), degradation studies (detection of transient species and molecular weight distribution) application of mechanical degradation: stress, induced chemical alterations of polymers, mastication of natural and synthetic rubber

UNIT- III

Photodegradation: introduction, mechanistic aspects (excited states, free radicals and ionic species, energy transfer and energy migration), degradation in the absence of oxygen (Norrish types I&II reactions), photo-oxidation (auto oxidative process, sensitized degradation), stabilization, application: polymers with a predictable lifetime, photoresists.

UNIT -IV

Degradation by high energy radiation and biodegradation: introduction, aspects of radiation, mechanistic aspects, simultaneous cross-linking and degradation, radiation stability application: lithography, x-ray resists in contact microscopy, graft and block copolymerization biodegradation, microbial degradation of synthetic polymers, general applications of biodegradable plastics, examples of biodegradable polyesters and polyamides.

UNIT-V

Chemical degradation: introduction, solvolysis, polymer characterization by solvolysis, stability of polymer against solvolytic agents, commercial applications, ozonization, oxidative degradation, auto-oxidation of polymers. Ionic degradation: alkaline degradation of polysaccharides, acidic degradation of polyaldehydes and polyacetals.

Text Books:

1. Polymer Degradation - Principles and Practical Applications by W. Schnabel, Hanser Publishers, New York, 1992.
2. Fundamentals of Plastics Testing, Sanjay K Nayak. et. al, Springer, USA, (2010).
3. The Complete Book on Biodegradable Plastics and Polymers (Recent Developments, Properties, Analysis, Materials & Processes) by NIIR Board of Consultants & Engineers, 2006

Reference Book:

1. Degradative Polymers Recycling and Plastic Waste Management by Ann - Christine Albertsson, Samuel J. Huang, Marcel Dekker, New York, 1995.
2. Handbook on Biodegradable Plastics (Eco Friendly Plastics), by NIIR Board of Consultants & Engineers, 2003
3. Ageing and Degradation of Polymer Nanomaterials by Vikas Mittal, Central West Publishing, 2019

Course outcomes:

Students will have a clear understanding of various types of degradation in plastics and their effect on plastics products.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)			
Name of program	:	Bachelor of Technology	Semester : V
Branch	:	Plastics Engineering	Code : C095533(095)
Subject	:	Polyurethane Technology (Professional Elective I)	Tutorial Periods : Nil
Theory Periods	:	2 per week	Assignments : Two (minimum)
Class Tests	:	Two (minimum)	Maximum Marks : 100
Exam. Duration	:	Three Hours	Minimum Marks : 35

Course Objectives

- Understand chemistry and materials of polyurethane manufacture
- Understand the production of flexible and rigid polyurethane foam
- Explain the knowledge of production, properties and uses of solid polyurethane
- Explain the knowledge of PU applications as coatings and adhesives

UNIT I

Introduction to polyurethane :

Chemistry and materials of polyurethane manufacture: basic reaction, cross-linking in polyurethane, important building blocks for polyurethane (isocyanates, polyols, amines and additives), the manufacture of polyurethanes (the process, parameters and controls).

UNIT II

Polyurethane processing:

Basic design principles of polyurethane processing equipment, steps in the polyurethane processing Flexible foams (production, properties and applications lab stock foam), carpet backing, flexible moulded foams & semi rigid moulded foams. Reinforced RIM: trends in the use of RIM and RRIM.

UNIT III

Rigid polyurethane foams :

Chemistry of raw materials, manufacturing of rigid polyurethane (manufacturing of buns, panels, foaming of applications, moulded rigid foams), properties, the relationship between production methods and properties,-application of rigid polyurethane, Polyurethane skin integral foam production, properties and applications.

UNIT IV

Solid polyurethane materials :

Polyurethane casting systems (cast elastomers and casting resins), thermoplastic polyurethane elastomers: productions/processing, properties and applications, polyurethane paints and coatings, adhesives builders, elastomer fibers, manufacture/processing and applications.

UNIT V

Determination of composition and testing of polyurethane:

Chemical compositions, detection methods, identification of function groups, determination of properties of materials and products (Characterization, physical/mechanical, temperature dependence, chemical performance and combustibility) polyurethane and environment health and safety: making and using polyurethane safely.

Text Books:

1. Polyurethane Hand Book by Dr. GunterOertal (ed.), Hanser Publication Munich.
2. The ICI Polyurethane book by George woods, published journals by ICI, John Wiley and sons NY

Reference Books:

1. Poly Urethanes by David Landel and Steve Lee, John Wiley 2002.
2. Poly Urethanes: Chemistry and Technology by James Henry Saunders and Kurtz Charles Frisch, R. E. Krieger, 1987.

Course outcomes:

Students will have a clear understanding of different types of polyurethane used in various industries.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)			
Name of program	:	Bachelor of Technology	Semester : V
Branch	:	Plastics Engineering	Code : C095534(095)
Subject	:	Special Processing Technology (Professional Elective I)	Tutorial Periods : Nil
Theory Periods	:	2 per week	Assignments : Two Minimum
Class Tests	:	Two (minimum)	Maximum Marks : 100
Exam. Duration	:	Three Hours	Minimum Marks : 35

Course Objectives

- Acquire the knowledge of various aspects of the casting process
- Familiarized with the process of Dip moulding
- Understand the process of printing on plastics using various techniques
- Understand the process of coating on plastics

UNIT - I

Casting Process

Introduction, Types (Conventional, Solvent, Rotational, Slush), Advantages & applications.

UNIT - II

Dip Moulding

Principle, Process, Materials, Inline & chain machines, Rotary machines, advanced machines, Advantages, Applications of dip moulding & dip coating, Limitations, Tooling requirements.

UNIT - III

Printing of Plastics

Principles, advantages, requirements, Types (Pad printing, Screen printing, Rotogravure, Laser printing, Hot stamping, Hot transfer printing, In-mold decoration, Film insert moulding, in mould transfer decoration)

UNIT - IV

Coating of Plastics

Extrusion coating, Calendar coating, Powder coating, Transfer coating, Knife roller coating, spray coating. Applications

UNIT - V

Machining of plastics

Principle, Different types of operations, Drilling, reaming, threading, and tapping, Sawing & cutting, Milling, Turning & boring, Punching, blanking die-cutting, Laser cutting, Polishing. Applications.

Text Books:

Plastic Engineering Hand Book & D – 5 - By Society of Plastic Industry Inc.
Plastics Material & Processing- By Strong, A, Brent

Reference Books:

1. Handbook of Applied Polymer Processing Technology by Cheremisinoff; Nicholas P. and Cheremisinoff; Paul N. (Eds.), Marcel Dekker Inc., New York (1996)
2. Plastics Materials & Processing - By Schwartz & Goodman Thermoforming - By James & Throne.

Course outcomes:

Students will have a clear understanding of the special processing techniques on plastics.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Name of program	: Bachelor of Technology	Semester	: V
Branch	: Plastics Engineering	Code	: C095521(095)
Subject	: Plastics Testing -I Lab	Tutorial Periods	: Nil
Lab. Periods	: 2 per week	Assignments	: Two (minimum)
Class Tests	: Two (minimum)	Maximum Marks	: 40
Exam. Duration	: Three Hours	Minimum Marks	: 20

Course Objectives

- To understand the procedure of mechanical and thermal testing
- To know the fix and variable parameters during testing.
- To understand the importance of environmental conditions and conditioning and their effect on test results.

List of Experiments

- 1) Testing of Tensile Strength, Elongation and Modulus on plastics materials/products
- 2) Testing of Compressive strength on plastics materials/products
- 3) Testing of Flexural strength on plastics materials/products
- 4) Testing of Izod and Charpy impact strength on plastics materials/products
- 5) Testing of Abrasion resistance on plastics materials/products
- 6) Testing of Burst Strength on plastics materials/products
- 7) Testing of Compression set on elastomer
- 8) Testing of Vicat softening point on plastics materials/products
- 9) Testing of Heat distortion temperature on plastics materials/products
- 10) Testing of Shrinkage on plastics materials/products
- 11) Testing of Thermal Aging on plastics materials/products
- 12) Testing of Flammability on plastics materials/products

Reference Book:

1. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph
2. Fundamentals of Plastics Testing, Sanjay K Nayak. et. al, Springer, USA, (2010).

Course outcomes:

After the study, students may be able to understand the importance of testing for specific applications and the selection of required tests based on end-use applications.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Name of program	: Bachelor of Technology	Semester	: V
Branch	: Plastics Engineering	Code	: C095522(095)
Subject	: Plastics Processing Technology-I Lab	Tutorial Periods	: Nil
Lab. Periods	: 2 per week	Assignments	: Two (minimum)
Class Tests	: Two (minimum)	Maximum Marks	: 40
Exam. Duration	: Three Hours	Minimum Marks	: 20

Course Objectives

- Understand the basic operation process of plastics processing techniques.
- Set and optimize the process variables for the improved efficiency of compression moulding, injection moulding, extrusion process and blow moulding techniques etc.
- Apply safety checkups before and during the operation of moulding machines.
- Apply preventive maintenance measures.

List of Experiments: Functioning , Parameter setting, operations, trouble shooting, maintainance, loading and unloading of mould etc.

1. Hand operated compression moulding
2. Hand operated injection moulding.
3. Semi-automatic injection moulding.
4. Automatic injection moulding.
5. Extrusion processes on extruders.
6. Hand operated blow moulding.
7. Semi-automatic blow moulding.
8. Scrap grinder.
9. Electrical and Mechanical maintenance along with the safety prospective to processing techniques i.e. compression, injection, extrusion and blow moulding.

Note: The above experiments will cover its functioning , parameter setting, operations, safety measures, trouble shooting, maintainance, loading and unloading of mould etc wherever applicable.

Reference Books:

1. Plastics Material & Processing By Strong, A, Brent.
2. Blow Molding Hand Book By Rosato, D.V & Rosato.
3. Plastic Extrusion Technology By Hen.
4. Fundamentals of Plastics Processing (Vol. 1) Injection & Blow Moulding, Sanjay K Nayak , S Sugumar, R T Nagaralli, TMH Publication, Vol. 1, 2014.
5. Technical Manual on Plastic Processing, Sanjay K Nayak et. al., CIPET internal publication, April 2007

Course outcomes: The Students will be able to-

- Select the appropriate processing technique based on the product.
- Select the particular machine based on the technical specification of the machine.
- Set the optimized process variables for improved efficiency.
- Troubleshoot and remedy of the defects produced.
- Apply maintenance and safety prospective before and during the running of the machine.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)					
Name of program	:	Bachelor of Technology	Semester	:	V
Branch	:	Plastics Engineering	Code	:	C095523(095)
Subject	:	Additives & Compounding Lab	Tutorial Periods	:	Nil
Lab. Periods	:	2 per week	Assignments	:	Two (minimum)
Class Tests	:	Two (minimum)	Maximum Marks	:	40
Exam. Duration	:	Three Hours	Minimum Marks	:	20

Course Objectives

- To know of different additives and their use to improve the properties of the polymer.
- To know the different techniques of incorporation of the additive into the polymer.
- To know the effect of additives on polymers.
- To know about how to make polymer compatible with each other.

List of Experiments

- 1) To carry out compounding of PP with various additives for specific applications.
- 2) To do PVC compounding using the high-speed mixture.
- 3) To carry out mixing of thermoplastics with rubber materials on two roll mill to analyze mixing time v/s speed of rolls, study effects using a microscope on morphology.
- 4) To study the effects of additives on the properties of LDPE.
- 5) To study the effects of additives on the properties of PP.
- 6) To study the effects of additives on the properties of PVC.
- 7) To study the effects of additives on the properties of ABS.
- 8) To carry out compounding of synthetic/natural fibers with thermoplastics materials using a twin-screw extruder.
- 9) To develop the colour masterbatch in thermoplastics materials using a twin-screw extruder.
- 10) To develop the compatible blend of two thermoplastic materials.

Reference Books:

1. Plastics additives handbook by Hans Zweifel, Hanser publication
2. Chemistry and Technology of polymer additives by Malaika Golovoy, Marcel Dekker publication

Course outcomes:

- Students will be able to select the specific additive based on the improvement required in the polymer.
- They will be able to select the compounding process based on polymer.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of the Program: **BTech**
Subject: **Environmental Studies**
Period per week (L-T-P): **(2-0-0) / Week**
Total Contact Hours: **40**

Semester: **V**
Code: **C000506(020)**
Non-Credit
No. of assignments to be submitted: **05**

PREREQUISITE: Knowledge of basic Chemistry, Physics and Mathematics.

COURSE OBJECTIVES:

1. Basic knowledge of environment, ecology, ecosystems, biodiversity and conservation.
2. Fundamentals of natural resources, control, uses and its impact on environment.
3. Human population, growth, growing needs and its impact on society and environment.
4. Types of environmental pollution, legislations, enactment and management.

COURSE DETAILS:

UNIT I: Introduction to environmental studies, ecology and ecosystems (06 hours)

Introduction to environment; Concept and structure of ecology and ecosystem, energy flow; Community ecology; Food chains and webs; Ecological succession; Characteristic features of forest, grassland, desert and aquatic ecosystem; Multidisciplinary nature of environmental studies, scope and importance; Concept of sustainability and sustainable development.

UNIT II: Biodiversity and conservation (06 hours)

Introduction to biological diversity and levels of genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots; Threats to biodiversity, habitat loss, conflicts and biological invasions; In-situ and Ex-situ conservation of biodiversity: Ecosystem and biodiversity services.

UNIT III: Natural resources and environment (08 hours)

Concept of Renewable and non-renewable resources; Land resources, land use change, land degradation, soil erosion; Desertification; Deforestation: causes, consequences and remedial measures; Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state); Energy resources: environmental impacts of energy generation, use of alternative and nonconventional energy sources, growing energy needs.

UNIT IV: Human communities, social issues and environment (08 hours)

Basic concept of human population, growth and communities; Impacts on environment, human health, welfare and human rights; Resettlement and rehabilitation; Environmental natural disaster: floods, earthquake, cyclones, tsunami and landslides; Manmade disaster; Environmental movements; Environmental ethics: role of gender and cultures in environmental conservation; Environmental education and public awareness; Human health risks and preventive measurements.

UNIT V: Environmental pollution, policies, legislations, assessment and practices (12 hours)

Environmental pollution: Causes, effects and controls of air, water, soil, noise and marine pollution; Concept of hazardous and non-hazardous wastes, biomedical and e-wastes; Solid waste management and control measures; Climate change, global warming, ozone layer depletion, acid rain and their societal impacts; Environment laws: Wildlife Protection Act, Forest Conservation Act, Water (Prevention and control of Pollution) Act, Air (Prevention & Control of Pollution) Act, Environment Protection Act, Biodiversity Act, International agreements negotiations, protocols and practices; EIA, EMP.

On completion of each unit, students have to submit one assignment from each unit.

COURSE OUTCOMES (CO):

On completion of the course, students will able to:

1. Interpret and demonstrate the concept of ecology and ecosystem for environmental sustainability.
2. Define and establish the diversified knowledge of biodiversity and its conservation.
3. Explain the uses of natural resources efficiently and its impact on environment.
4. Illustrate and solve the simple and complex social issues relating to human communities.
5. Exemplify and make useful solution to combat the environmental degradation with the aid of national and international legislations and protocols there under.
6. Demonstrate and elucidate the complicated issues and anthropological problems for societal development.

TEXT BOOKS:

1. De, A.K., (2006). *Environmental Chemistry*, 6th Edition, New Age International, New Delhi.
2. Bharucha, E. (2013). *Textbook of Environmental Studies for Undergraduate Courses*. Universities Press.
3. Asthana, D. K. (2006). *Text Book of Environmental Studies*. S. Chand Publishing.

REFERENCE BOOKS:

1. Odum, E. P., Odum, H. T., & Andrews, J. (1971). *Fundamentals of ecology*. Philadelphia: Saunders.
2. Basu, M., Xavier, S. (2016). *Fundamentals of Environmental Studies*, Cambridge University Press, India.
3. Sharma, P. D., & Sharma, P. D. (2005). *Ecology and Environment*. Rastogi Publications.

OPEN SOURCE LEARNING:

<http://nptel.ac.in/>