



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VII Semester: B.Tech.: Plastic Technology

7PT4-01: PLASTIC WASTE MANAGEMENT AND RECYCLING METHODS

Credit: 3

Max. Marks: 150 (IA: 30, ETE: 120)

3L+0T+0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Introduction to Plastic waste management and recycling methods: Plastic waste generation source, composition, quantities, need and benefits Municipal solid waste and composition- recycling of plastics from urban solid wastes, household waste – industrial sector, Plastics recycling classification code of practice. Circular economy and plastic pollution control rules. Recycling methods - Primary, Secondary, tertiary recycling of plastics.	10
3	Separation techniques and processing of commingled plastic waste: Plastic identification methods physical, chemical, flotation, solvent separation and melt filtration Plastic production and composition, separation of resin from fiber in waste FRP. Size reduction of recycled plastics-cutting/shredding, densification, pulverization and chemical size reduction of recycled plastics. Processing of commingled/mixed plastic waste-super wood, plastic lumber	10
4	Recycling of various plastics: Recycling of polyolefins based products- Recycling of PET based products – PVC recycling, Recycling of polycarbonate, Nylon and ABS, Recycling of thermoset plastic waste, pyrolysis and energy recovery	10
5	Recycled Plastics end-use applications: Single use plastics recycling, healthcare Plastic waste recycling, Use of recycling plastics in food packaging, Use of recycling plastics in construction and architecture.	10
	Total	41

Text Books:

1. Anthony L. Andrady (Ed.), “Plastics and the Environment”, Wiley Interscience, New York, 2003.
2. Francesco Paolo La Mantia, “Recycling of Plastic Materials (Ed)”, Chem Tech Publishing.
3. Nabil Mustafa, “Plastics Waste Management, Disposal Recycling and reuse”, Marcel Dekker, inc. New York, 1993.
4. Nabil Mustafa, Marcel Dekker, “Plastics Waste Management (Ed)”, New York, 1995.

5. John Scheirs, "Polymer recycling, science, technology and applications", John Wiley & Sons, England, 1988.

Reference Books:

1. Ann Christine Albertson and Samuel J. Huang, Marcel Dekker, "Degradable polymer, recycling and Plastic waste management (Eds), New York.
2. Dr. J.S.Anand, "Recycling & Plastics Waste Management" CIPET, 1997.
3. R.J.Ehrig, Plastics Recycling, Products and Processes, Hanser Publishers, New York, 1992.
4. Technologies in Plastics Recycling, American Chemical Society, Washington, DC, 1992.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VII Semester: B.Tech.: Plastic Technology

7PT4-02: NANOMATERIALS AND THEIR APPLICATIONS

Credit: 3

Max. Marks: 150 (IA: 30, ETE: 120)

3L+0T+0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nanoparticles- quantum dots, nanowire ultra-thin films-multilayered materials. Length Scales involved and effect on properties:	10
3	Nanomaterials and their Synthesis procedures: Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT), Nanometal oxides- ZnO, TiO ₂ , MgO, ZrO ₂ , NiO, nanoalumina, CaO, AgTiO ₂ , Quantum wires, Quantum dots- preparation, properties and applications. Methods of synthesis- Top down approach, Bottom up approach, Template based synthesis, Production and use of nanotubes, nanorods, nanowires, Physical Vapour Deposition (PVD), Chemical Vapor Deposition (CVD).	10
4	Characterizations of nonomaterials: Structural characterization, Physical characterization, Physical properties of nonmaterial. X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SIMS-Nanoindentation.	10
5	Applications of nanomaterials: healthcare, biosensors, coatings, environment, catalysis, agriculture, automotives, electronics, photonics, information technology, quantum computing, energy sector and aerospace sector.	10
	Total	41

Text Books:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.
3. T. Pradeep, Nano: The Essentials, McGraw-Hill (India) Pvt Limited (2008).

Reference Books:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VII Semester: B.Tech.: Plastic Technology

7PT4-03: ELASTOMER TECHNOLOGY

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA: 30, ETE: 120)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	NATURAL RUBBER: Tapping latex, Processing of Latex - Dry rubber production (Smoked sheet, air dried sheet, Crepe etc.) - Grading of rubbers - Modified natural rubber, Reclaimed rubber - process of reclamation.	10
3	COMPOUNDING DESIGN AND VULCANIZATION: Sulphur vulcanization and non-sulphur vulcanization, vulcanization systems - accelerators, activators, promoters, antioxidants, antiozonants, processing aids, fillers and effect of fillers, Blowing agents etc.	10
4	SYNTHETIC and THERMOPLASTIC ELASTOMERS: Manufacturing, structure, properties, compounding, curing and applications - Polyisoprene, Polybutadiene, SBR, EPDM, Butyl rubber, Neoprene, Nitrile rubber, Silicone rubber, Polysulphide rubber, polyurethane rubber, Acrylic rubber, Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, polyamide thermoplastic elastomers, Polyurethane thermoplastic elastomers.	10
5	RUBBER PRODUCT MANUFACTURING: Manufacturing of Belting, Hoses, Footwear, sports goods, tyres	10
Total		41

Text Books:

1. C.M.Blow and Hepburn, - Rubber Technology and Manufacture, 2nd edition, 1982.
2. Hoffman, Rubber Technology Handbook -, Hanser Pub. Munich – 1996
3. C. Keith Riew, “Rubber toughened Plastics, American Society
4. John Dick, ”Rubber Technology” Hanser Gardner Publications

Reference Books:

1. Anil .K. Bhowmic, Howard L. Stephens (Edt), Handbook of Elastomers – New Developments & Technology, Marcel Decker Inc. New York 1988.
2. Maurice Morton, Rubber Technology.,1998.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VII Semester: B.Tech.: Plastic Technology

7PT4-21: ADVANCE ENGINEERING LAB-I

Credit: 1
0L+0T+2P

Max. Marks: 50 (IA: 30, ETE: 20)
End Term Exam: 3 Hours

List of Experiment

1. Study of Elements by Energy-Dispersive X-Ray Fluorescence (ED-XRF) spectrometer
2. Evaluate thermal transitions in polymer by Differential Scanning Calorimetry (DSC)
3. Analysis of the thermal properties of polymer by Thermogravimetric Analysis (TGA)
4. Determination of Contact angle and surface tension of various solutions by Contact angle Goniometer system.
5. PLC Programming
 - Ladder programming on Logic gates, Timers & Counters
 - Ladder programming for digital & Analogy sensors
 - Ladder programming for Traffic Light Control, Water Level Control and Lift control Modules.

Important Note:

It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

4th Year – VII Semester: B.Tech.: Plastic Technology

7PT4-22: ADVANCE MOULD ANALYSIS LAB

Credit: 1
0L+0T+2P

Max. Marks: 50 (IA: 30, ETE: 20)
End Term Exam: 3 Hours

List of Experiment

1. Introduction and practice on 3D modeling using UG NX/CREO/CATIA.
2. Demonstration and practice on Mould Flow software
3. Designing and analysis of Hand Injection mold for single and double impressions.
4. Designing and analysis of Multi impression two plate Injection Mould.
5. Designing and analysis of Three Plate Injection Mould (multi-impression)
6. Designing and analysis of Split Injection Mould-without delayed action (Advance Mould)
7. Designing and analysis of Split Injection Moulding
8. Designing and analysis of Roto mould and Thermoform Mould.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VIII Semester: B.Tech.: Plastic Technology

8PT4-01: ADDITIVE MANUFACTURING FOR POLYMER PRODUCTS

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA: 30, ETE: 120)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Introduction to Additive Manufacturing (AM): AM evolution- Distinction between AM & CNC machining- Advantages of AM- AM process chain- Conceptualization- CAD- conversion to STL Transfer to AM- STL file manipulation- Machine setup-build -removal and clean up-post processing- Classification of AM processes	8
3	DESIGN FOR AM: Motivation- DFMA concepts and objectives- AM unique capabilities- Exploring design freedoms- Design tools for AM- Part Orientation- Removal of Support- Hollowing out part- Inclusion of Undercuts and Other Manufacturing Constraining Features- Interlocking Feature- Reduction of Part Count in an Assembly- Identification of markings / numbers etc.	9
4	SOLID & LIQUID BASED AM: Liquid Based AM: Stereolithography Apparatus (SLA) - Solid Ground Curing (SGC) - Principle, pre-build process, part-building and post-build processes, resins, Advantages, limitations and applications Solid Based AM: Fused deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) -Principles, details of processes, materials, advantages, limitations and applications.	9
5	POWDER BASED AM: Selective Laser Sintering (SLS) - Laser Engineered Net Shaping (LENS) - Principles, details of processes, materials, advantages, limitations and applications.	9
6	POST PROCESSING & APPLICATIONS OF AM: Post processing of AM parts: Support material removal - Surface texture improvement- Accuracy improvement - Aesthetic improvement - Preparation for use as pattern- Property enhancements using non-thermal and thermal techniques. Functional models- Pattern for investment and vacuum casting – Medical models - art models - Engineering analysis models- Rapid tooling.	9
Total		45

Text Books:

1. J B Park, Bio-materials, An Introduction –, CRC Press, 2003.
2. J S Brydson, Plastics Materials –.

3. H.F. Mark (Ed), Encyclopedia of polymer science and engineering, John Wiley and Sons New York, 1989.

REFERENCES:

1. Comprehensive Polymer Science Vol.7 Alcock., Contemporary Polymer Chemistry.
2. Second Ed. Manas Chanda, Salil K. Roy (Ed) Plastic Technology Hand Book Marcel Dekker, Inc. New York, 1993
3. Dekker, Inc. New York, 1993
4. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
5. Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing.,2012.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VIII Semester: B.Tech.: Plastic Technology

8PT4-02: ADHESIVES AND SURFACE COATINGS

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA: 30, ETE: 120)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Adhesives - Concepts and terminology, functions of adhesives, advantages and disadvantages of adhesive bonding, theories of adhesion-mechanical theory, adsorption theory, electrostatic theory, diffusion theory, weak-boundary layer theory, requirements for a good bond, criteria for selection of adhesives.	10
3	Types of adhesives: Structural adhesive and non-structural adhesives, Urethane structured adhesives, Modified acrylic structural adhesives, phenolic adhesives and modifiers, anaerobic adhesives, cyanoacrylate adhesives, hot melt adhesives, pressure sensitive adhesives, RTV Silicone adhesives, sealants, water based adhesives. Specialty adhesives, adhesives in aerospace, adhesive in automobile industry, conductive adhesives, adhesives in building construction, adhesive in electrical industry.	10
4	Introduction to surface coatings: -Components of paints. Pigments, pigment properties, different types, extenders, solvents, oils, driers, diluents, lacquers, varnishes, paint preparation, formulation, factors affecting pigment dispersion, preparation of pigment dispersion. Different types of paints- classification based on polymeric resin, emulsion, oil and alkyd paints, acrylic paints, epoxy coatings, polyurethane, silicones, formaldehyde based resins, chlorinated rubbers, hydrocarbon resins. Classification based on application, fluropolymers, vinyl resins, appliance furnishes, automotive finishes, coil coatings, can coatings, marine coatings, aircraft coatings.	10
5	Surface preparation and paint application. Paint properties and their evaluation - mechanism of film formation, factors affecting coating properties, methods used for film preparation – barrier properties, optical properties, ageing properties, rheological properties and adhesion properties of coatings.	10
	Total	41

Text Books:

1. Gerald L. Schreberger, “Adhesive in Manufacturing”, Marcel Dekker Inc., New York, 1983

2. W.C. Wake, "Adhesion and the Formulation of Adhesives", Applied Science Publishers, London, 1976.
3. Premamoy Ghosh, Adhesives and Coatings Technology, (2008)
4. Formulating Adhesives and sealants, B. Muller, Walter lath, (2010).

Reference Books:

1. Swaraj Paul, "Surface Coatings", John Wiley & Sons, NY, 1985.
2. George Mathews, "Polymer Mixing Technology", Applied Science Publishers. Shields,
3. "Hand Book of Adhesives", Butterworths,1984



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

IV Year – VIII Semester: B.Tech.: Plastic Technology

8PT4-03: BIOMEDICAL PLASTICS

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA: 30, ETE: 120)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	BIOMATERIALS: Biomaterials, Biocompatibility, Stabilization, Inflammation and Wound Healing, Blood Clotting System, skin System, Biological response to Implants, Implant Design And Applications.	9
3	BIOMEDICAL POLYMERS: Criteria for the Selection of Biomedical Polymers Physicochemical Aspects of the Blood Compatibility of Polymeric Surface. Biomedical Polymers from biological source, Poly hydroxyl Alkanoic Acids, Microbial polysaccharides, Silk, Collagen. , Microbial Cellulose, Hyaluronic Acid, Synthetic Polymers suchas PMMA, Silicone Rubber, Polyethylene, Natural Rubber, Hydrogels.	9
4	BIOMEDICAL APPLICATIONS OF POLYMERS: Permanent Implants For Function-Orthopedics, Cardio Vascular, Respiratory Patches andTubes, Digestive System, Genitourinary System, Nervous System, Orbital (Corneal And LensProsthesis)–Permanent Implant For Cosmose, Other Applications of Engineered Material InClinical Practices, Silicone Implants. Polymer Membranes, Polymer Skin, Polymeric Blood.	9
5	POLYMERIC LENSES: Contact Lenses, Hard Lenses, Gas Permeable Lenses, Flexible Lenses, Soft Lenses, Hydrogels,Equilibrium Swelling, Absorption And Desorption, Oxygen Permeability, Types of Soft Lenses, Manufacture, Cleaning And Disinfection.	8
6	DENTAL POLYMERS: Dental applications, denture bases, crown and bridge resins, plastic teeth, mouth protectors, maxillofacial prosthetic materials, restorative material, polyelectrolyte based restoratives, sealants, adhesives, dental impression and duplicating materials, agar, algmater elastomers.	9
Total		45

Text Books:

1. J B Park, Bio-materials, An Introduction –, CRC Press, 2003.
2. J S Brydson, Plastics Materials –.
3. H.F. Mark (Ed), Encyclopedia of polymer science and engineering, John Wiley and Sons
4. New York, 1989.

Reference Books:

1. Comprehensive Polymer Science Vol.7 Alcock., Contemporary Polymer Chemistry.
2. Second Ed. Manas Chanda, Salil K. Roy (Ed) Plastic Technology Hand Book Marcel
3. Dekker, Inc. New York, 1993
4. Chiellini; Emo, Sunamoto; Junzo, Migliaesi; Claudio, Ottebrite; Raphael and Cohn;
5. Daniel (Eds.), Biomedical Polymers and Polymer Therapeutics, Kluwer
6. Academic/Plenum Publishers, New York (2001).
7. Galaev; Igor and Mattiasson; Bo (Eds.), Smart Polymers; Applications



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Syllabus

IV Year – VIII Semester: B.Tech.: Plastic Technology

8PT4-21: ADVANCE ENGINEERING LAB -II

Credit: 1
0L+0T+2P

Max. Marks: 50 (IA: 30, ETE: 20)
End Term Exam: 3 Hours

List of Experiment

1. Study of Spin coating process
2. Determine the amounts of carbon (C), hydrogen (H), nitrogen (N), sulfur (S) and oxygen (O) present in a given sample by CHNSO Elemental analyzer
3. Study of High resolution Inductively coupled Plasma Optical Emission Spectrometer (ICP-OES)
4. Study of UV-Vis spectroscopy
5. Study of Gas Chromatography-Mass Spectrometry (GC-MS)
6. Performance characteristics of a Colour spectrophotometer
7. Determination of flammability by Limiting Oxygen Index (LOI) Tester



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IV Year – VIII Semester: B.Tech.: Plastic Technology

8PT4-22: ADVANCE POLYMER PROCESSING LAB

Credit: 1
0L+0T+2P

Max. Marks: 50 (IA: 30, ETE: 20)
End Term Exam: 3 Hours

List of Experiment

1. Study and demonstration of FDM/FFF based 3D printer machine.
2. Study of various printing parameters such as Printing speed, Infill pattern and density, Raster thickness and angle, nozzle temperature etc.
3. Study and hands on practice of slicing method on any slicing software.
4. Preparation of filament for printing using PLA, PC, ABS and fillers reinforced materials.
5. Manufacturing of article using prepared filament on FDM based 3D Printer.
6. Testing and inspection of printed article with respect to product design.
7. Study of SLA and SLS methods of additive manufacturing.