

Syllabus of
UNDERGRADUATE DEGREE COURSE

Plastic Technology

V & VI semester



Rajasthan Technical University, Kota
Effective from session: 2022-23



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT3-01: MECHANICS OF SOLIDS

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Stress and Strain: Elementary definition of stress and strain, stress- strain relationship, elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, elastic constants and their relations for an isotropic hookean material, anisotropic and orthotropic materials. Tension, compression, shearing stress and strain, thermal stresses, composite bars, equations of static equilibrium, concept of free body diagram.	7
3	Members Subjected to Flexural Loads: Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams. Bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. Strain energy due to bending.	7
4	Principal Planes, Stresses and Strains: Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain. Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications.	7
5	Torsion: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads. Stability of Equilibrium: Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.	8
6	Transverse Deflection of Beams: Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method. Thin-walled Pressure Vessels: Stresses in cylindrical and spherical Vessels, thin walled pressure vessels; energy methods (Castigliano's Theorems); Euler buckling. Vibrations: Free vibration of undamped single degree of freedom systems.	8
Total		38



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3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. Rajput.R.K., “Strength of Materials”, S.Chand and Co, New Delhi, 6th edition, 2015.
2. Bhavikatti. S., “Solid Mechanics”, Vikas publishing house Pvt. Ltd, New Delhi, 2010.
3. R.S.Khurmi., “Strength of Materials”, S.Chand & Co, New Delhi

Reference Books:

1. Gambhir. M.L., “Fundamentals of Solid Mechanics”, PHI Learning Private Limited., New Delhi, 2009.
2. Timoshenko.S.B. and Gere.J.M, “Mechanics of Materials”, Van NosReinbhold, New Delhi 1995.
3. Vazirani.V.N and Ratwani.M.M, “Analysis of Structures”, Vol I Khanna Publishers, New Delhi, 1995.
4. Junnarkar.S.B. and Shah.H.J, “Mechanics of Structures”, Vol I, Charotar Publishing House, New Delhi 1997.
5. Ugural. A.C., “Mechanics of Materials”, Wiley India Pvt. Ltd., New Delhi, 2013.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT4-02: PROPERTIES & TESTING OF PLASTIC-I

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Standards, Specifications & Testing- Standard and specifications- National and International standards-BIS,ASTM, ISO,BS,DIN,JIS etc- Laboratory accreditations – NABL, NABCB, APLAC etc., Test Specimen	5
3	Identification of Plastics- visual inspection, melting & Softening point, effects of heat, density, elemental analysis, combustion and solvents analysis, confirmation test analytical techniques used for identification and quantification of additives and fillers. Rheological properties – Melt flow Index, Melt viscosity (as function of temperature and shear rate)	5
4	Mechanical Properties- Preconditioning and test atmosphere, Specimen preparation techniques-Moulding, Contour cutting, contour punching, etc. Techniques for testing of Short term mechanical properties of Plastics – Stress – Strain curve, toughness, brittle and ductile nature of materials, Tensile, Flexural, Compression, Shear, Impact strength, Tear, abrasion, Hardness and friction test.	8
5	Optical properties –Luminous transmittance, Haze, Specular Gloss, Refractive Index, colour measurement, optical microscopy, light transmission, clarity, gloss, colour guard and microscope	6
6	Electrical Properties- Techniques for testing of Electrical properties- Insulation resistance, power factor, Permittivity Surface & Volume Resistivity, Arc Resistance, CTI, Dielectric Strength, Dielectric constant and Dissipation factor-	8
7	Thermal Properties- Techniques for testing of Thermal properties – Melting Point, glass transition temperature, thermal conductivity thermal dependent properties, Specific heat capacity, Heat deflection temperature, Vicat softening temperature, Flammability (Rate of burning, UL 94, LOI), Ignition properties of plastics. Thermal conductivity, Coefficient of Thermal Expansion, Brittleness Temperature, Marten’s heat resistance test, low temperature brittle point and flexibility test, thermal stability, thermal ageing and flammability	7
Total		40



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. Shah, Vishnu, “Hand Book of Plastics Testing Technology”, John Wiley and Sons, SPE Monograph, 1984.
2. Allen; W.S and Baker; P.N, “Hand Book of Plastics Technology”, Volume 2, Identification.
3. Brown; Roger P (Ed.), “Hand Book of Polymer Testing, Marcel Dekker”, Inc, New York 1999.

Reference Books:

1. Brown; Paul F (Ed), “Hand Book of Plastics Test Methods”, Longman Scientific and Technical, Harlow, 1988.
2. Testing & Recycling of Plastics, CBS Publishers and distributors, New Delhi, 2004.
3. Blythe; A. R., “Electrical Properties of Polymers”, Cambridge University Press, Cambridge, 1979.
4. Blythe; Tony and Bloor; David, “Electrical Properties of Polymers”, 2nd edition, Cambridge Press.
5. Mitcheli Jr., John, “Applied Polymer Analysis and Characterization-Recent Development in Techniques, Instrumentation, Problem Solving,” Hanser Publishers.
6. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT4-03: PLASTIC PROCESSING TECHNOLOGY-I

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Basic Principles of Processing — Effect of polymer property on processing – Newtonian and Non-Newtonian fluids – Role of rheology in polymer processing	4
3	Injection Moulding- Basic principles of injection, Processing variables, Mould cycle, Types of Injection Moulding Machines, Screw, Moulds, Material Selection for Injection Moulding, Clamping Systems, Machine operations, Machine selection, Plastic melt behavior inside barrel & mould, Machine operation, Process controls, Machine controls, Post moulding operations, Faults & Remedies.	8
4	Extrusion Moulding- Basic principles of extrusion, type of extruders, screw and their output in terms of drag, leakage and pressure flow, influence of screw dimensions and output, die and screw characteristics. Design of barrel and screw for commodity, heat sensitive and engineering polymers. Barrier Screws, Factors affecting the output of an extruder, process variables in extrusion. Individual extrusion systems, Dies, Sizing and Downstream equipments, Faults, Causes and Remedies for film, pipe, lamination, profiles, cables, sheet, Box Strapping. Twin Screw Extrusion- Twin-screw extrusion and Co Extrusion systems. Casting of films. Multi layer systems for Films and Pipe. Faults, causes & remedies	9
5	Compression and Transfer Moulding- Fundamental principles of compression and transfer moulding- Process variables- Curing time- Meaning of terms-Bulk factor and flow properties as applied to moulding materials-The methods adopted for estimating these properties and their limitations Process variables, Types of compression mould- Common moulding faults and their correction Finishing of moulding. Transfer moulding and its application in processing of thermosetting materials. Advantages over compression moulding-Line pressure-clamping- Heating Requirements- Moulding Faults, Causes & Remedies.	9
6	Calendaring, Casting and Coating Process- Principle and process description, types of calender units, Design of calender roll, Heating and temperature control, roll crown, roll crossing and roll bending, materials for calendaring, calendaring sheets and films, embossing, coating and lamination by calender, comparison between calendaring and extrusion. Casting Processes - Introduction – casting processes viz: Mould casting, Embedding /potting, Encapsulation –Dip casting-slush casting Roto casting, cell casting, static powder casting, continuous casting, solvent casting, operation and control of above casting processes plastisol processing. Coating Process - Introduction-Roller coating methods, powder coating-fluidized bed coating, Electro static spray coating-Equipment, process and applications.	9
Total		40

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. Allen; W. S. and Baker; P. N., “Hand Book of Plastic Technology”, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors, New Delhi, 2004.
2. Rubin Irvin, “Injection Molding Theory & Practice”, Wiley-Interscience, 1973.
3. D.V Rosato, D.V. Rosato & M.G. Rosato, “Injection Molding Hand Book”, 3rd edition, Kluwer academic publishers, 2000.
4. A. Brent Strong, “Plastics Material & Processing”, 3rd edition, Prentice Hall, 2005.
5. D.V. Plastic Engineering Hand Book & D-5 By Society of Plastic Industry Inc., 2000.
6. Rosato, D.V & Rosato, D.V, “Blow Molding Hand Book”.
7. Hensen, “Plastic Extrusion Technology”.
8. Fisher, “Extrusion of Plastics”.
9. Grief, “Plastics Extrusion Technology”.
10. S P I, “Plastic Engineering Hand Book”, 1991.
11. Henson, “Plastics Extrusion Technology”, 1997.

Reference Books

1. Bolur, P.C., “A Guide to Injection Molding of Plastics”, Allied Publishers, 2000.
2. Whelan, A & Craft, J.L., “Development in Injection Molding” Elsevier, 1985
3. Grandilli, P.A., “Technician’s Hand Book & Plastics”, 1990.
4. Schwartz & Goodman, “Plastics Materials & Processing”, Nostrand Reinhold, 1982.
5. Athalye, A.S., “Injection Molding”, 1997.
6. V.D.I., “Injection Molding Technology”.
7. Stevenson, “Innovation in Polymer Processing”, 1996.
8. Giles, H.H., “Extrusion The definitive Processing Guide and Hand Book”, 2004.
9. Iyeseu, A.I., “Compression Molding”
10. Rauwedaal, Chris, “Polymer Extrusion”, 2014.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

SPT4-04: PLASTIC PRODUCT & MOULD DESIGN

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Plastic Product Design: Plastics product design - Concepts - Essential factors - Principles - Methodical approach -process variables vs product design. Uniform and symmetrical wall thickness - Draft angle- Rib design – Fillets & Radius - Bosses - Holes -Threads - standard thread forms - undercuts - Hinges - metal inserts - parting line –Tolerances- Design for manufacturing and assembly. Fundamentals of Mold Making: selection of materials for mold making, Mechanism of metal cutting, types of tools, influence of tool angles, Cutting fluids. Basics of machining operations: Turning, Cylindrical Grinding, Surface Grinding & Vertical Milling.	8
3	Process Planning & Cost Estimation: Production and productivity – methods of increasing productivity – expectations for productivity. Process Planning: Definition – Objectives – Scope – approaches to process planning, documents in process planning. Cost Estimation: Introduction: Material cost and Labour cost, Objective of cost estimation make or buy decision, Zero base budgeting - costing – cost structure on components & its accounting-classification of cost- Elements of cost. Types of estimates – methods of estimates.	8
4	Injection Mould Design: Introduction -General mould construction- Mould design concepts - mould elements - parting line and parting surface- construction of core and cavities Bolsters - mould alignment, Feed system- Sprue, runner, gate & position of gate - runner & gate balancing. Ejection - types of ejections - mould cooling -venting- ancillary parts. Two plate mould - three plate - external undercut- split mould, Side cores, Split and side core actuation-Finger cam-Dog leg cam - cam track - delayed action - hydraulic, internal undercut-form pin-collapsible core - loose cores, threaded inserts - internal and external threads-unscrewing moulds-hot runner moulds.	8
5	Blow Mould Design: Types of blow moulds - extrusion - injection and stretch blow moulds - blow ratio - parison design - pinch off design - parting line - clamping force -mould venting, mould cooling - mould alignment. Extrusion Die Design: Principles of Extrusion- Die Geometry – Die swell – Die Land Design- Sizing die design- Construction of Extrusion dies – blown film- pipe- profile- flat filmsheet – Wire Coating and Co-Extrusion Dies.	8
6	Compression Mould Design: Types of compression mould, open flash, semi-positive type, positive, displacement moulds, types of loading chambers, bulk factor, flash thickness, pot design, projected area, compression pressure, clamping force, no. of impression by technological method, heating system, types of heaters, heat loss, heat requirement & heater capacity. Transfer Mould Design: Types of transfer moulds, integral pot transfer mould, auxiliary ram transfer mould, transfer pot design, projected area, transfer pressure, clamping force, pressure pad design, design of sprue, runner and gate, advantages and disadvantages of transfer mould - design related calculations.	7
Total		40

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. KlusStokhert (Edt.), “Mold making handbook for Plastic Engineers”, Hanser Publishers, 2nd edition, 1998.
2. HMT Production Technology, Tata Mc Graw Hill (India), 1992.
3. Plastics Mould design, Tata McGraw-Hill Education , 2007.
4. Beck, R, “Plastics Product Design”.
5. Pye R.G.W, “Injection Mould Design”.
6. Gastrow, “Injection Moulds 130 Proven Design”.
7. T.R Banga and S.C Sharma , “Mechanical Estimating and Costing”.

Reference Books:

1. C-B & Liv C.N.K., “Computer aided design & manufacture”, East West Press
2. P.C.Pandey & H.S. Shah, “Modern Machining Processes”, TMH, 1990.
3. Stoeckert & Menning, “Mold making handbook”, 2nd edition, Carl Hanser Verlag GmbH & Company KG, 2013.
4. W.A.J Chapman, “Workshop Technology Part 2”, Taylor & Francis Group, 2016.
5. George Menges & Paul Mohren, “How to Make Injection Molds”, Hanser Publishers, 2001.
6. Sinha.B.P. “Mechanical Estimating and Costing”, Tata McGraw-Hill, Publishing Co., 1995.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology
5PT4-05: POLYMER COMPOSITES

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Introduction to composite materials- Classifications-Metal matrix composites, Ceramic matrix composites, polymer composites-general properties and applications. Principles of composite reinforcement. Effect of reinforcement on composite properties.	7
3	Resins and reinforcements for composites- Thermoplastic and Thermosetting matrix materials, Reinforcements-Types and Forms-particulate, flake, fibrous etc., coupling agents, special purpose thermosets	7
4	Theory of composite materials- Calculation of composite properties- mechanism of load transfer, minimum and critical fiber content, critical fiber length- Rule of mixtures – Halpin -Tsai - equation.	7
5	Processing of composites- Composites processing techniques - hand lay-up, spray-up, bag molding, resin transfer molding (RTM), filament winding, pultrusion, prepregs, SMC, DMC, compression moulding, injection moulding.	9
6	Characterization of composites- Mechanics of composites-Fracture and damage mechanics - laminates –delamination - Measurement of physical and mechanical properties: density-fiber volume fraction-void content, test for tensile-compression-flexural in fiber direction –Non- Destructive Evaluation Methods for Composites – Visual Inspection, Ultrasonic Methods, X-Ray Imaging. Control of particle/fiber and porosity content, particle/fiber distribution, Interfacial reaction of matrix-reinforcing component, Coating of reinforcing component.	9
Total		40

Text Books:

1. J.A.Brydson, “Plastics Materials”, Butterworth- Heinemann - Oxford, 6th edition 1995.
2. S.T.Peters, “Handbook of Composites”, Chapman& hall, 2nd edition 1998.

Reference Books:

1. G. Lubin, “Hand Book of Composites”, 2nd Ed, Van Nostrand Reinhold, New York, 1982.
2. F.L. Matthews and R.D. Rawlings, “Composite materials: engineering and science”, Chapman and Hall, 1994.
3. P.K. Mallick, “Composites Engineering Handbook”, Marcel Dekker Inc.NY., 1997.
4. D. Hull and T. W. Clyne, “An introduction to Composite Materials 2nd edition, Cambridge, 1996.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

SPT5-11: ADDITIVES AND COMPOUNDING

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Types and mechanism of additives for plastics- Fillers, Antioxidants, Thermal Stabilizers, Lubricants, Plasticizers, Toughening-agents, Colourants, Fire retardants, Coupling agents, blowing agents, Ultraviolet stabilizer, Antistatic agents, Anti blocking agents, Slip and antislip agents, processing aids, mould releasing agents.	9
3	Compounding- Selection of polymers and compounding-ingredients-general objectives- Merits and demerits of additives in polymer matrices. Compounding Machineries specifications - temperature control system – operating characteristics and working details of continuous mixers - Single Screw extruder - Twin Screw extruder- housekeeping and maintenance of compounding machines.	8
4	Mixing and mixing equipments- Distributive and Dispersive mixing, Compounding by batch mixer- High speed mixer - Two roll mill - Banbury Mixer - Ribbon blender - Planetary mixers. Intensive and Extensive Mixers - Machine construction - specifications - temperature control system - operating characteristics. Pelletizers.	8
5	Case Studies- Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.	9
Total		35

Text Books:

1. Al – Malaika; S. Golovoy; A and Wilkie (Eds), “Chemistry and Technology of Polymer Additives”, Black well Science Ltd, Oxford, 1999.
2. Matthews; F.L. and Rawlings; R.D, “Composite Materials”, Engineering and Science Chairman and Hall, London, 1994.
3. Vishu Shah, “Plastics Testing Technology Hand Books”, 1984.

Reference Books:

1. Brown R.P., “Hand Book of Plastics Test Methods”, 1989.
2. Mascia; L., “The Role of Additives in Plastics”, Edward Arnold Publishers Ltd., U. K. 1974.
3. Murphy; John, “Additives for Plastics Handbook”, 2nd edition, Elsevier Advanced Technology, Oxford, 2001.
4. R. Gachter and H. Muller, Plastics Additives Hand Book, Hanser Publishers, Munich, 1993.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT5-12: POLYMER PHYSICS

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Fundamentals of Polymer Physics- Tacticity, isomeric states and isomerism in polymers, Potential energy and conformational energy of molecules - conformations and configurations, stereoisomerism, geometric isomerism - Random coils and average end to end distance - (Derivation only)	8
3	Thermodynamics of polymers- Laws of Thermodynamics - Freely jointed and freely rotating chain models - Entropy and enthalpy Energy driven and entropy driven elasticity - Thermo elasticity -Thermodynamic treatment - entropic and energetic contributions (Derivation only).	8
4	Polymer crystal configuration- Crystalline State - polymorphism – Polymer single crystals, lamellae, spherulites – Crystallinity -factors affecting crystallinity -X-ray diffraction, Amorphous State - Transition temperatures- Glass transition temperature Theory- Factors influencing glass transition Temperature.	9
5	Chain orientation and polymer solutions- Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers – Uniaxial and biaxial orientation. Polymer solutions - Terms and definitions, types of solutions - Hildebrand approach, Flory Huggins theory - Thermodynamic view of miscibility, Critical solution temperatures.	9
Total		35

Text Books:

1. Ulf W. Gedde, “Polymer Physics”, Springer – Science +Business Media, B.V. 1st edition, 43, 2001.
2. S. Glasstone and D. Lewis, “Elements of Physical Chemistry”, Textbook Publishers, 2003.
3. Cowie;J. M. G., Polymers: Chemistry and Physics of Modern Materials, 2nd Edition, Blackie and Sons Ltd., Glasgow, 1991.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT5-13: FIBER TECHNOLOGY

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Criteria for fiber forming polymers- Production of synthetic - commercial synthetic fibers, raw materials manufacture. caprolactum, adipic acid, DMT, TPA, MEG, acrylonitrile, hexamethylene diamine, polymerization - types of polymers - production of polyethylene terephthalate polymer - polyamides - production of nylon 66 polymer - nylon 6 polymer.	9
3	Fiber manufacture techniques- Melt spinning - Polymer feed - melt spinning equipment - high speed spinning - spin draw processes - Production of acrylic fibers - polypropylene - production of other fibers - PVC fibers - PVA fibers - Aramid fibers - crystallization method - melt spinning of PET & PP staple fibers - wet and dry spinning comparison. Spin finishes - functions of spin finish - methods of application of spin finish - spin finish for polyester staple fibers - spin finish for texturing process - effect of spin finish on dyeing.	9
4	Fiber drawing processes- Conditions of drawing - machines for draw warping - texturing -false twist process - draw texturing- staple fiber production, melt spinning - drawing, heat setting - crimping in fiber line - production of melt spin staple fiber - polyester tops for wool blending - Mass coloration and tow dyeing of polyester, nylon, acrylic -polypropylene - dyeing in loose fiber and yarn forms of polyester, nylon, acrylic, PP, other synthetic fiber - loose fiber dyeing.	9
5	Testing of fibers and yarn - Testing raw material - testing polymers - testing yarns & fibers - waste utilization of polyester - nylon 6 – 66 - acrylics - PP- Energy conservation - pollution control.	8
Total		36

Text Books:

1. A.A. Vaidya, "Production of synthetic fibres", Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

Reference Books:

1. Fourné, Franz, "Synthetic Fibres, Machines and Equipment, Manufacture, Properties", Hanser Publishes, 1999.
2. Corbman Bernard P., "Textiles: fibre to fabric", 6th edition, McGraw Hill, 1983.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT4-21: PLASTIC PRODUCT TESTING LAB-I

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)
End Term Exam: 2 Hours

List of Experiment

1. Introduction of product testing
2. Preparation of test specimen using Injection moulding, Contour cutting, and Contour punching.
3. Determine the water absorption for plastic materials
4. Study of wreathing properties
5. Study of mechanical properties of plastics and test methods
6. Determine the compressive strength of rigid plastics
7. Determine the compressive strength of polymeric foams.
8. Determine the hardness (Shore A & D, Barcol and Rockwell) of plastic materials
9. Determine the abrasion resistance of plastic materials
10. Determine the tear strength of films
11. Study of flammability properties of plastics: Rate of burning, Oxygen Index Tester



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT4-22: PLASTIC PROCESSING LAB-I

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)
End Term Exam: 2 Hours

List of Experiment

1. Introduction to maintenance- Basic knowledge of Hydraulic & Pneumatic systems, Electrical system.
2. Moulds study: Study of different types of moulds & its parts and function, free hand drawing practice, exposure to tool room machines, mould maintenance & Storage
3. Study of Hand operated injection moulding process
4. Study of semi automatic injection moulding process- Study of Machine in Idle-Run Observation (IRO), free sketch of Machine, Study of Parts & their function. Practice on Die setting, Cycle time analysis, Start up and shut down Procedure.
5. Extrusion Process – Free sketch of Machine, Study of Parts & their function. Practice on Die setting, Cycle time analysis, Start up and shut down Procedure.
6. Twin screw extrusion process, Study of Parts & their function. Practice on Die setting, Cycle time analysis, Start up and shut down Procedure.
7. Compression Moulding or Transfer Moulding Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
8. Plastics coating Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
9. Calendaring process – Study of Two roll mill process
10. Scrap grinding – Study of Machine in Idle-Run Observation (IRO), study of parts & function, Line Diagram of M/c. (ii) Operation-practice with different materials and output study in Kg/hour for different materials.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT4-21: PLASTIC PRODUCT & MOULD DESIGN LAB

Credit: 2
0L+0T+4P

Max. Marks: 100 (IA: 60, ETE: 40)
End Term Exam: 3 Hours

List of Experiment

Mould Design using CAD

1. Injection Mould design: Design calculations for No. of cavities, Selection of injection moulding machine, shot capacity, plasticizing rate, Clamping force and 2D/3D Modeling for Two plate, Three Plate and split Moulds.
2. Compression Mould Design: Design calculations for No. of cavities, Flash thickness allowances, Design of loading chamber, Bulk factor, Pressure pad, Heaters and 2D/3D Modeling for Compression Mould.
3. Transfer Mould Design: Design calculations for Pot, Bulk factor, Heaters and 2D/3D
4. Modeling for Pot and Plunger transfer Moulds.
5. Blow Mould Design: Design calculations for Clamping force, pinch-off, Head die design, Parison dimensions and 2D/3D modeling for blow mould.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT7-30: INDUSTRIAL TRAINING	
Credit: 2.5	Max. Marks: 100 (IA: 60, ETE: 40)

Students had undergo mandatory 45 days in-house/Industry training after IV semester.
Training examination will be held in V semester.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

5PT8-00: SOCIAL OUTREACH, DISCIPLINE & EXTRA CURRICULAR ACTIVITIES (SODECA)	
Credit: 0.5	Max. Marks: 100



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT3-01: ENGINEERING THERMODYNAMICS

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Basic concepts and definitions of Thermodynamics: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work. Zeroth and First Law of Thermodynamics: Zeroth of Thermodynamics, Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	7
3	Second Law of Thermodynamics: Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Planck and Clausius statements. Reversible and Irreversible, Processes, Carnot engine, Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausius Inequality. Entropy, Calculation of Entropy change, Principle of entropy, increase. Temperature-Entropy diagram, Second law analysis of a control volume.	8
4	Thermodynamic Properties of Fluids: Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart Ideal Gas and Real Gas: Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures	7
5	Thermodynamic Relations: Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation.	7
6	Vapour power cycle: Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	7
Total		37

Text Books:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics", 5th edition, 2017.
2. Yunus a. Cengel & michael a. Boles, "Thermodynamics", 8th edition, 2015.
3. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2013.

Reference Books:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Borgnakke & Sonntag, "Fundamental of Thermodynamics", 8th Edition, 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology
6PT4-02: PROPERTIES & TESTING OF PLASTIC-II

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Permanence and Weathering Properties: Permanence Properties: Environmental stress cracking resistance-ageing-gas permeability-water vapour permeability-Water absorption-soluble and insoluble matter-chemical resistance. Weathering properties: Xenon arc weatherometer-Weather and Climatic impact on properties of plastics-UV-A and UV-B weathering- Accelerated weathering.	9
3	Analytical Techniques: Principles and analysis of polymer samples- Differential scanning calorimeters (DSC), Thermogravimetric Analysis (TGA), Thermomechanical Analysis (TMA), Dynamic Mechanical Analyzer (DMA), X-ray diffraction (XRD), X-ray fluorescence (XRF), Scanning Electron Microscope (SEM), Transmission Electron Microscopes (TEM), Gel permeation Chromatography (GPC), Gas Chromatography (GC), Atomic absorption spectroscopy (AAS), Fourier transform infrared spectroscopy (FTIR).	10
4	Product Testing: Testing of plastics pipes and fittings, film and sheets, FRP based products, woven sack, Water bottles and containers, Electrical Conduits, emitters and laterals.	9
5	Failure Analysis: Failure analysis of products and its measurement techniques Concepts of non-destructive testing.	9
Total		38



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. Shah, Vishnu, “Hand Book of Plastics Testing Technology”, John Wiley and Sons, SPE Monograph, 1984.
2. Brown; Roger P (Ed.), Marcel Dekker, “Hand Book of Polymer Testing”, Inc, New York 1999.
3. Allen; W.S and Baker; P.N, “Hand Book of Plastics Technology”, Volume 2, Identification.
4. Testing & Recycling of Plastics, CBS Publishers and distributors, New Delhi, 2004.
5. Allen, W.S & Baker P.N., “Hand Book of Plastics Technology” 2 volume.

Reference Books:

1. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc
2. Brown; Paul F (Ed), “Hand Book of Plastics Test Methods, Longman Scientific and Technical”, Harlow
3. Blythe;A. R, “Electrical Properties of Polymers”, Cambridge University Press, Cambridge, 1979.
4. Blythe;Tony and Bloor; David, “Electrical Properties of Polymers”, 2nd edition, Cambridge Press.
5. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc
6. Mitcheli Jr.; John, “Applied Polymer Analysis and Characterization-Recent Development in Techniques”, Instrumentation, Problem Solving, Hanser Publishers.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT4-03: PLASTIC PROCESSING TECHNOLOGY-II

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Thermoforming Process: Various stages of thermoforming process, various methods of forming, Vacuum Forming, techniques, Pressure forming techniques, Advantages and disadvantages of thermoforming, Applications of thermoforming Process, Material requirements, Thermoforming Machines, Single stage sheet fed machine, Multiple stage sheet fed machine, In-line sheet fed machine, Continuous roll fed machine, Packaging machines, Processing Requirements, Heating methods, Temperature control, Vacuum/air pressure, Cooling, Trimming, Process Variables, Trouble Shooting.	9
3	Blow Moulding: Basic principles and definitions, process, material & design considerations, types of blow moulding machines, Extrusion blow moulding, accumulation blow moulding, Continuous & intermittent, trimming operation, parison programming, Injection blow moulding, Injection stretch blow moulding, single stage & two stage operation, Common faults & remedies. Multi layer Blow moulding.	9
4	Rotational Moulding/Surface treatment/Metallization: Basic principles and definitions process, advantages & disadvantages, material requirements, Rotational moulding machines, rotational moulding moulds, part design, process variables, common faults & remedies. Surface treatment: Pre-treatment methods, Mechanical abrasion, Flame treatment, Chemical etching, Corona treatment, Plasma Treatment, Electrical surface treatment, Applications. Metallization: Vacuum Metallization (Vacuum evaporation, sputtering), Plating (Electroless Plating, Electrolytic Plating).	9
5	Secondary Process/Post moulding/Joining & assembling: Introduction-Importance of machining – methods viz; cutting, drilling, blending, filling etc., joining principles-cohesion principle, adhesion principle – solvent cementing. Dop cementing, Mechanical connection, Gluing (solvent bonding, adhesive bonding, theory of adhesion), Welding (Vibration welding, Spin welding, Ultrasonic welding, Hot-plate welding, Induction welding, Laser welding, Radio frequency welding, Resistance welding, Hot gas welding, Staking), Electro plating and vacuum metalizing	9
Total		37

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

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3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. Grandilli, P.A., “Technician’s Hand Book & Plastics”, 1981
2. Strong, A, Brent, “Plastics Material & Processing”.
3. Plastic Engineering Hand Book & D – 5 - By Society of Plastic Industry Inc.

Reference Books:

1. Schwartz & Goodman., “Plastics Materials & Processing”, 1982.
2. Stevenson, “Innovation in Polymer Processing”,1996.
3. James & Throne., “Thermoforming”, 2013.
4. Crawford, R.J & Throne, J.L., “Basic Principle of rotational molding”.
5. Bruins, “Basic Principle of Rotational Molding”.
6. Brycle, D.M., “Basic Principle of Thermoforming”.
7. New Man, “Welding of Plastics”.
8. Rosato DV “Blow molding hand book”



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT4-04: MOULD MANUFACTURING TECHNOLOGY

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Types of Steels used for mould manufacturing- Mild Steel, Alloy Steel, Die Steel etc, mould steel requirement – characteristics – alloying elements – material selection for different parts of the Mould and their heat treatment. Non ferrous materials – Aluminum -copper – bronze – beryllium copper-synthetic rubber and its significance as a material for Mould making.	8
3	Introduction to Jig Boring Machine- Working Principle-edge finder-locating microscope, Digital Read Out (DRO) - Types of tools and cutter used on jig boring and their materials. Types of measuring instruments used for inspection of job & their working principle. Application of Jig boring machine in mould manufacturing. Pantograph- construction-working principle-tools-single lip cutters & profiles-single lip grinding machine. Templates – purpose, types, materials, methods of making templates, Introduction to Master and difference between Template and Master. Alignment of work piece and Template. Pantograph ratio.	7
4	Electrical Discharge Machining – working principle-construction- generator parameters-spark gap calculations, Electrodes – Materials used, properties and its application – wear ratios - Electrode design consideration. Die electric fluids –requirement, characteristics – Flushing – Purpose and different types of flushing. Troubleshooting – Faults and remedies.	8
5	Hobbing For Mold Making: Discussion of the hobbing process & its advantages, elements of hobbing like hobbing punch, shape of the hob, materials used for cavity. Polishing technology in mold making: Definition of surface roughness, basis of polishing technology, Effect of mold materials on polishability, Types of polishing tools, Methods of polishing. Basic information on Electro sonic polishing. Principles of Electro deposition in damaged molding surfaces. Surface Texturing of molds - Process description, types of molds, types of patterns and mold shapes, metals that can be etched, mold preparation, limitations of chemical texturing.	8
6	Mould assembly: Mould assembly-check list for mould assembly-fitting and assembly of various mould elements- core insert, cavity insert, sprue bush-ejection system assembly-blue matching and die spotting-venting -final inspection-fitting of locating ring and carrier bar- mould trial.	8
Total		40



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

Text Books:

1. KlusStokhert (Edt.), “Mold making handbook for Plastic Engineers”, Hanser Publishers, 2nd edition, 1998.
2. HMT Production Technology, Tata Mc Graw Hill (India), 1992.
3. Plastics Mould design, Tata McGraw-Hill Education , 2007.
4. Beck, R., “Plastics Product Design”.
5. Pye R.G.W., “Injection Mould Design”.
6. Injection Moulds 130 Proven Design Gastrow.

Reference Books:

1. C-B & Liv C.N.K., “Computer aided design & manufacture, East West Press P.C.Pandey & H.S. Shah, Modern Machining Processes, TMH, 1990.
2. Stoeckhert & Menning, “ Mold making handbook”, 2nd edition, Carl Hanser Verlag GmbH & Company KG, 2013.
3. W.A.J Chapman, “Workshop Technology- Part 2”, Taylor & Francis Group, 2016.
4. George Menges& Paul Mohren, “How To Make Injection Molds”, Hanser Publishers, 2001



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT4-05: POLYMER BLENDS AND ALLOYS

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Introduction and classification of polymer blends and alloys- Definition of polymer blends and alloys - Classification - Criteria for selection of polymer – Thermodynamics of miscibility – Phase morphology – Phase separation behavior - Determination of morphology of polymer blend – Mechanical compatibility - Electron Microscopy	8
3	Compatibilization and reactive blending- Introduction – Compatibilization mechanisms – Compatibilization methods compatibilization by addition of copolymer reactive blending – Future trends.	8
4	Rheology of polymer blends- Introduction – Miscibility and flow behaviour of polymer blends – Immiscible blends Flow behaviour of immiscible and miscible polymer blends. Complex flow processing of polymer blends flow through a contraction.	8
5	Preparation and types of polymer blends and alloys- Principles and methods involved in preparation of Polymer blends and alloys - Interpenetrating polymer network: Synthesis, Morphology, Properties and application of polymer blend - Enhancement of polymer miscibility – utilization of miscible polymers. Liquid Crystalline Polymer, Blends-Ternary Polymer – Elastomer, Blends-Polymer blends containing block copolymers- Biodegradable polymer blends- Recycled polymer blends	8
6	Application of polymer blends and alloys- Application of Blends in Emerging technology - Photovoltaic, Light Emitting Diode, Electro chromic, Electric conductivity polymer and blends, Lithium battery & Fuel cells Applications.	7
Total		40

Text Books:

1. Lloyd M. Robeson, “Polymer Blends: A Comprehensive Review”, Hanser Publishers, 2007
2. D. R. Paul and S. Newman, “Polymer Blends Vol. I & II”, Academic Press Inc, 1978.

Reference Books:

1. Olabisi, I. W. Rubison and M T Shaw “Polymer-Polymer Miscibility Academic Press” NewYork 1979.
2. Utracki, “Polymer Blends and Alloys”, Hanser Publisher.
3. G. Lubin, “Hand Book of Composites”, 2nd edition, Van Nostrand Reinhold, NY, 1982.
4. S.M.Lee, “Dictionary of Composites Materials Technology”, Technomic Lancaster, Pa, 1989.
5. B.T.Astrom, “Manufacturing of Composites”, Chapman & Hall, 1997.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT5-11: PLASTIC PACKAGING TECHNOLOGY

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Selection criteria for flexible packing Materials- Major packaging plastics PE, PP, PS, PVC, polyesters, PVDE, vinyl acetate, PVA, EVA, PV Alcohol, PA,PC ionomers, fluoro polymers. Packaging legislation and regulation, Special packaging for food and medical packaging, Advantages and disadvantages of polymeric packages over conventional packing materials.	9
3	Types of Packaging:- Bubble wrapping, Shrink wrapping, Pallet & stretch wrapping, stretch and shrink wrap. Thermoformed packages: Position and thermoforming , wrap forming, variations in thermoforming and solid phase pressure forming, scrabbles, twin sheet and melt – to-mold thermoforming, skin packaging, thermoforming moulds, thermoforming fill- real.	8
4	Extrusion, film and flexible packaging – Extrusion, Blow film, Multi layer film ,sheet, coatings, cast film, sheet laminations, co-extrusions , pouching , sealing , evaluation of seals in flexible packages, advantages of flexible packaging – flexible packaging products. Sealing methods, Plasma barrier coatings.	8
5	Selection criteria- suitable polymeric packages for oils, fats and allied products, soaps and detergents, cosmetics, food, dairy products, beverages, medicines, chemicals, paints, household and industrial goods, etc.	8
6	Testing plastic packages- Barrier, Migration and compatibility, printing, labeling and pigmenting, Sterilization for health care products. Packaging hazards and their controls, Environmental concern for packaging material.	6
Total		40

Text Books:

1. Susan E.M. Seleke, “Understanding Plastic Packaging Technology”, Hanser Publications.
2. A.S. Altalye, “Plastics In Packaging”, Tata Mcgraw–Hill Publishing Co.Ltd., New Delhi.

Reference Books:

1. Arabinda Ghosh, “Technology of Polymer Packaging” Hanser; 1st edition, 2015.
2. Sajid Alavi, Sabu Thomas, K.P. Sandeep, Nandakumar, “Polymers for Packaging Applications”.
3. Briston; John H. and Katan; Leonard L., “Plastics in Contact with Food”, Food Trade Press Ltd London.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT5-12: THERMOPLASTIC ELASTOMERS

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Introduction- Introduction to Thermoplastic Elastomers (TPE), Classification of Thermoplastic Elastomers, Basic structure, Manufacture, Morphology, Commercial grades and Applications	6
3	Polyolefin based thermoplastic elastomers – Block copolymer, Random Block polymers, Graft copolymers, Polyolefin blend TPE's, preparation, properties, processing and applications. Manufacture, Properties and applications of Styrenic Thermoplastic Elastomers, Polyester thermoplastic elastomers,	8
4	Polyamide and polyester based thermoplastic elastomers- Preparation, properties, and applications. Thermoplastic Polyether ester elastomers – Synthesis, Properties and applications..	8
5	Thermoplastic Elastomers from Conventional Polymers- Polyvinylchloride based Thermoplastic Elastomers – PVC/Nitrile Rubber blends, PVC/Polyurethane blends. Thermoplastic Polyurethane Elastomer – Raw materials, Synthesis, Properties, Processing, Blends and their applications.	8
6	Thermo Plastic Elastomer Blends Preparation of Elastomer – Plastic blends by dynamic vulcanization, properties and applications. Ionomeric Thermoplastic Elastomers: Synthesis, Properties and applications of ionomeric elastomers.	8
Total		39

Text Books:

1. Anil K. Bhowmick, Howard L. Stephens, “Hand Book of Elastomers”.
2. Marcel Dekker, “New Developments and Technology”, , Inc., New York, 1988.
3. Benjamin M. Walker, “Hand Book of Thermoplastic Elastomers”, Van Nostrand Reinhold Company, New York, 1979.

Reference Books:

1. Briston; John H. and Katan; Leonard L., “Plastics in Contact with Food”, Food Trade Press Ltd., London.
2. Jiri George Drobny, “Handbook of Thermoplastic Elastomers Book”.
3. G. Holden, “Understanding Thermoplastic Elastomers”.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT5-13: POLYMERS FOR ENVIRONMENT AND ENERGY STORAGE APPLICATIONS

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA: 30, ETE: 70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objectives, scope and outcome of the course	1
2	Introduction of energy storage systems- Background on alternative energy sources and sustainability, Electric-based transportation, Overview of Space-Marine-Land vehicle electrification, Basic concept of regenerative braking energy, features of polymers and their applications in energy and electronics, Impact of polymers from an environment	9
3	Synthesis and electrochemistry of conducting polymers- Synthesis of conducting polymers – chemical, electrochemical and enzymatic methods – doping – general considerations – measurement of conductivity – van der Pauw technique, Electrochemistry of electronically conducting polymers-source of electronic conduction in polymers – solitons, polarons and bipolarons – semiconductors and conducting polymers.	9
4	Characterization of conducting polymers - Electro analytical techniques – cyclic voltammetry, chronoamperometry and chronocoulometry, spectral methods - use of UV-vis, Raman, XRD and NMR.	9
5	Energy based polymers applications- Lithium-Ion Batteries based on polymers, Super capacitor, photovoltaic devices. Piezoelectric transducers, light-emitting conjugated polymers, electromechanical actuators, EMI shielding, sensor devices, conductive composites	9
Total		37

Text Books:

1. H. Peng, X. Sun, W. Weng, X. Fang “Polymer Materials for Energy and Electronic Applications”, Academic Press, 1st edition, 2017.
2. Skotheim.T.A., Elsenbaumer.R.L. and Reynolds J.R., “Hand book of Conducting Polymers”, Marcel Dekker Inc., New York, 2nd edition, 1998.
3. Margolis J.M., “Conducting Polymers and Plastics”, Chapman and Hall, London, 1989.

Reference Books:

1. Seymour R.B., “Conductive Polymers”, Plenum Press, New York, 1981.
2. Wessling B., “Electronic Properties of Conjugated Polymers,” Vol.3, Springer, Berlin, 1989.
3. Kiess H.G., “Conjugated Conducting Polymers,” Springer, Berlin, 1992.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT4-21: PLASTIC PRODUCT TESTING LAB-II

Credit: 2
0L+0T+4P

Max. Marks: 100 (IA: 60, ETE: 40)
End Term Exam: 3 Hours

List of Experiment

1. Preparation of polymer blends using twin screw extruder, and preparation of test specimens.
2. Preparation of polymer compounds using two roll milling and preparation of test specimens.
3. Testing of HDPE and UPVC pipes as per IS:4984 and IS:4985
4. Testing of LDPE Films as per IS: 2508
5. Testing of HDPE/PP Woven Sacks and tapes
6. Testing of roto moulded Water Storage Tanks
7. Testing of milk packing pouches
8. Testing of electrical properties of plastics: Arc resistance, Surface and Volume resistance, Comparative tracking index (CTI), Dielectric strength, Dielectric constant and dissipation factor.
9. Testing of meter box cover
10. Testing of baby feed bottles
11. Testing of irrigation product-Lateral, Emitters, Quick coupled pipes
12. Testing of FRP laminates/sheets.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT4-22: PLASTIC PROCESSING LAB-II

Credit: 2
0L+0T+4P

Max. Marks: 100 (IA: 60, ETE: 40)
End Term Exam: 3 Hours

List of Experiment

1. Automatic Injection Moulding Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
2. Micro-Processor Controlled Injection Moulding Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
3. Thermoforming (Vacuum forming) Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
4. Hand operated blow moulding process - Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch.
5. Automatic Blow moulding Process – Free sketch of Machine, Study of Parts & their function, Parison die. Practice on Die centering, Cycle time analysis, Start up and shut down Procedure
6. Rotational Moulding Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
7. Plastics coating Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
8. Plastics Sealing Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
9. Plastics welding Process – Free sketch of Machine, Study of Parts & their function. Cycle time analysis, Start up and shut down Procedure.
10. Fiber Reinforced Plastics (FRP) process: Study of types of Resin, fibers used in the process, sequence of Process operation in Hand-layup/RTM process, operation Practice for Hand-layup/RTM Process for producing FRP-products
11. Maintenance work on processing machines: Practical exposure to the preventive maintenance checkpoints for all processing M/cs. Daily startup and shut down maintenance checks, housekeeping checking hydraulics and electrical circuit for safety, routine faults and remedies.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT4-23: MOULD MANUFACTURING TECHNOLOGY LAB

Credit: 2
0L+0T+4P

Max. Marks: 100 (IA: 60, ETE: 40)
End Term Exam: 3 Hours

List of Experiment

1. Study of different types of Cutting tools.
2. Letter writing on Pantograph Machine.
3. Study of EDM.
4. Study of Wire cut EDM
5. Study and Detailing of mould assembly
6. Manufacturing of Guide Pillar and Guide Bushes by using Lathe Machine.
7. Manufacturing of Pocket By Milling
8. Study of Hot runner mould
9. Hand compression mould design – positive, semi positive, displacement type mould, and design with split cavities
10. Transfer mould design (pot type & top plunger type)
11. Study of Mould for Rotational Moulding.
12. Study of Mould for Thermoforming Moulding.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year – V & VI Semester: B.Tech.: Plastic Technology

6PT8-00: SOCIAL OUTREACH, DISCIPLINE & EXTRA CURRICULAR ACTIVITIES (SODECA)	
Credit: 0.5	Max. Marks:100