

त्रिपुरा विश्वविद्यालय

TRIPURA UNIVERSITY

(केन्द्रीय विश्वविद्यालय)
(A CENTRAL UNIVERSITY)

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NOTIFICATION

Date: 17/02/2017

The first meeting of Board of Postgraduate Studies (BPGS) for the Department of Chemical & Polymer Engineering, Tripura University, will be held on 7th March 2017 (Tuesday) at 1.00 PM in the chamber of Head of the Department. The following agenda will be discussed in the meeting.

1. To prepare academic calendar for the Department of Chemical & Polymer Engineering.
2. To finalize syllabus for M.Tech course in Chemical & Polymer Engineering.
3. To finalize syllabus for PhD course work.
4. To approve list of question paper setters and moderators.
5. To report departmental purchase related issues (Major & Minor instruments)
6. Miscellaneous.

All members are requested to make it convenient to attend the meeting.


(Prof. M.K. Singh)

Dean, Faculty of Science
Tripura University

1. Prof. Ramgopal Uppaluri (External Member, IIT Guwahati)
2. Prof. D. Khashtagir (External Member, IIT Kharagpur)
3. Prof. Dipankar Chattopadhyay (External Member, University of Calcutta)
4. Prof. M.K. Singh (Member, Dean, Faculty of Science, TU)
5. Shri. Harjeet Nath (Member, Faculty of Chemical & Polymer Engineering, TU)
6. Dr. Alok Prasad Das (Member, Faculty of Chemical & Polymer Engineering, TU)
7. Dr. Prasanta Kumar Rout (Member, Faculty of Chemical & Polymer Engineering, TU)
8. P.S. Vice-Chancellor, TU for information
9. P.S. Dean, Faculty of Science (TU) for information and necessary action
10. The Finance Office, TU for information and necessary action


(Prof. M.K. Singh)

Dean, Faculty of Science
Tripura University



**Department of Chemical and Polymer Engineering
Tripura University**

Proceedings of the first meeting of Board of Post-Graduate Studies (BPGS) held on 07.03.2017 in Chemical and Polymer Engineering department, Tripura University at 1 p.m.
Members present

1. Prof. Anjan Mukherjee, Pro-Vice-Chancellor, & Chairman(Dean in- charge), Tripura University
2. Prof. Ramgopal Uppaluri, External Member, Faculty of Chemical Engg., IIT Guwahati
3. Prof. D. Khastagir, External Member, Faculty of Rubber Technology, IIT Kharagpur
4. Prof. Dipankar Chattopadhyay, External Member, Faculty of Polymer Science and Technology, University of Calcutta.
5. Dr. Prasant Kumar Rout, External Member, Faculty of Material Science and Engg., Tripura University
6. Dr. Alok Prasad Das, Internal Member, Faculty of Chemical and Polymer Engg., Tripura University
7. Shri. Harjeet Nath, Internal Member, Faculty of Chemical and Polymer Engg., Tripura University

At the start, Prof. Anjan Mukherjee, Pro-Vice-Chancellor, & Chairman (Dean in-charge), has welcomed all the members to the first BPGC meeting and then, the meeting has started for the discussions on the following agendas.

Agenda 1: To finalize the syllabus for M.Tech. Course in Department Chemical and Polymer Engineering, TU

Syllabi of 1st Semester and 2nd semester were reported to the meeting as the course had already started and it was accepted. The detailed structure of the old syllabus is given in Table 1. The members felt that the need of modification in syllabi of 1st and 2nd semester which would be offered in the next sessions. The modification suggested and approved in the meeting are given in Table 2. The syllabus for 3rd and 4th semester is given in Table 3.

The final complete syllabus (4 semesters) to be followed for the upcoming batches and approved by the BPGS committee is given in Table 4.

Table 1: Detailed syllabus for 1st and 2nd semester students of Dept. of Chemical and Polymer Engineering (1st Batch that started in Academic session 2016-17).

1st Semester 600 Marks			
Theory Papers (code)	Name	Credit	Marks
CP 901C	Bioprocess Engineering	4	100
CP 902C	Introduction to Polymer Science and Technology	4	100
CP 903E	Fluidization Engineering (elective offered to other dept.)	4	100
CP 904E	Food Technology	3	100
<i>Elective to be taken from other department as per Institute Rules</i>	<i>Respective Course</i>	4	100
Practical Papers	Name		Marks
CP 905C	Polymer Science and Technology Lab	2	50
CP 906C	Bioprocess Engineering Lab	2	50
2nd Semester 600 Marks			
Theory Papers (code)	Name		Marks
CP 1001C	Advanced Heat Transfer	4	100
CP 1002C	Polymer Processing	4	100
CP 1003C	Advanced Reaction Engineering	4	100
CP 1004E	Biohydrometallurgy	3	100
<i>COMPUTER SKILL III (As per Institute Rules)</i>	<i>Soft Computing Skills III</i>	4	100
Practical Paper	Name		Marks
CP 1005C	Polymer Processing Lab	2	100

Table 2: Modified syllabus for 1st and 2nd semester students of Dept. of Chemical and Polymer Engineering for upcoming batches after recommendation by external experts of departmental BPGS committee.

1st Semester

Existing Subject Code	Existing Subject Name	Modified Subject Code	Modified Subject Name
CP901C	Bioprocess Engineering	CP901C	Advanced Reaction Engineering
CP902C	Introduction to Polymer Science & Tech	CP902C	Polymer Science & Technology
CP903E	Fluidization Engg.	CP903C	Heat and Mass Transfer
CP904E	Food Technology	CP904C	Polymer Engineering Lab
CP905C	Polymer Sci. & Tech Lab	CP905C	Reaction Engineering Lab
CP906C	Bioprocess Engg. Lab	CP906E	Rubber Science and Technology
		CP907E	Colloids and Interface Science
		CP908E	Polymer Recycling and Uses

2nd Semester

Existing Subject Code	Existing Subject Name	Modified Subject Code	Modified Subject Name
CP1001C	Advanced Heat Transfer	CP1001C	Advanced Fluid Flow & Rheology
CP1002C	Polymer Processing	CP1002C	Polymer Characterization and Testing
CP1003C	Advance Reaction Engg.	CP1003C	Polymer characterization Lab
CP1004E	Biohydrometallurgy	CP1004E	Polymer Processing
CP1005C	Polymer processing Lab	CP1005E	Fluidization Engineering
		CP1006E	Biomaterials
As per University	Soft computing Skills III	As per University	Soft computing Skills III

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Dean and Chairperson, BFS of Science, T.U. University.

Approved in BFS meeting of Science, T.U. University.

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Table 3: Syllabus for 3rd and 4th Semester students of Dept. of Chemical and Polymer Engineering

3rd Semester

Existing Subject Code	Existing Subject Name	Modified Subject Code	Modified Subject Name
CP1101C	Project (Literature review+ objectives + Hypothesis + Progress report writing)	CP1101C	Project (Literature review+ objectives + Hypothesis + Progress report writing)
CP1102C	Progress Seminar + Viva-Voce	CP1102C	Progress Seminar + Viva-Voce

4th Semester

CP1201C	Project (Literature review + Methodology + Final Thesis Submission	CP1201C	Project (Literature review + Methodology + Final Thesis Submission
CP1202C	Comprehensive Seminar + Viva-Voce	CP1202C	Comprehensive Seminar + Viva-Voce

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Table 4: Final BPGS approved syllabus for 4 semester M.Tech programme in Chemical and Polymer Engineering.

Total Core (C) Credits: 54, Total Elective (E) Credits: 18, Total Credits: 72

1st Semester (600 Marks)				
Theory Paper (code)	Name	Credits	Marks	
CP 901C	Advanced Reaction Engineering	4	100	
CP 902C	Polymer Science and Technology	4	100	
CP 903C	Heat and Mass Transfer	4	100	
Dept. Elective (Students to select any one from the list)	CP906E	Rubber Science and Technology	4	100
	CP907E	Colloids and Interface Science	4	100
	CP908E	Polymer Recycling and Uses	4	100
Other Elective	Elective to be taken from other department (compulsory)	4	100	
Practical Papers	Name	Credits	Marks	
CP904C	Polymer Lab	2	50	
CP905C	Reaction Engineering Lab	2	50	
2nd Semester (550 Marks)				
Theory Paper (code)	Name	Credits	Marks	
CP1001C	Advanced Fluid Flow & Rheology	4	100	
CP1002C	Polymer Characterization and Testing	4	100	
Dept. Elective (Students to select any two from the list)	CP1004E	Polymer Processing	3	100
	CP1005E	Fluidization Engineering	3	100
	CP1006E	Biomaterials	3	100
Other Elective	Skill 3 (Compulsory elective offered by University)	4	100	
Practical Papers	Name	Credits	Marks	
CP1003C	Polymer characterization Lab	2	50	
3rd Semester (300 Marks)				
Project Identification, literature Survey and Plan of Work (Project: Phase-I)				
Paper	Name	Credits	Marks	
CP 1101C	Project (Literature review + Objectives+ Hypothesis + Progress Report Writing)	8	200	
CP 1102C	Progress Seminar + Viva- Voce	4	100	

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4 th Semester (400 Marks)			
Project Implementation (Project: Phase-II)			
Paper	Name	Credits	Marks
CP1201C	Project (Literature review+Methodology+Final Thesis)	10	250
CP1202C	Comprehensive Seminar + Viva-Voce	6	150

It was decided in the meeting that internal members of the committee would prepare the contents of the courses and send them to external members for their considerations and modifications. External members would also provide additional textbooks and reference books names, if required. The same has been done by both the internal and external experts of the BPGS committee and has been incorporated.

Agenda 2: To finalize syllabus for PhD courses

The committee has suggested to follow the University guidelines to prepare PhD syllabus and has also suggested following things for integral assessment of PhD students.

1. State of art seminar: It includes fundamentals, solving area of research, how fundamentals are connected to the research area etc.
2. Yearly progress seminar report

Agenda 3: To consider the nomenclature for the degree to be awarded by the university in the department of Chemical and Polymer Engineering.

It was proposed in the meeting that the nomenclature of the degree to be awarded for the said course would be “**M.Tech in Chemical and Polymer Engineering**” and not “M.Tech in Polymer and Rubber Technology” which was previously proposed in the resolutions of the consultative meeting regarding starting of Chemical and Rubber Technology Department sanctioned by UGC held on 29.08.2014. With the change in the name of the department from “Department of Chemical Engineering and Rubber Technology” to “Department of Chemical and Polymer Engineering” as per the reference letter F.TU/REG/MISC-04/14, the BPGS has decided to propose the above new nomenclature. Hence the proposal of the change in the nomenclature to “**M.Tech in Chemical and Polymer Engineering**” would be put in the next BFS Meeting followed by its approval and further action (If any) by the next Academic Council Meeting of Tripura University.

Agenda 4: To set the eligibility criteria for admission into M.Tech and Ph.D.

The matter was discussed and approved the existing eligibility criteria for admission into M.Tech. Course i.e B.E./B.Tech. in Chemical Engineering/Polymer Engineering,/Chemical and Polymer Engineering/Plastic Engineering/Biotechnology/ Environmental Engineering or M.Sc. in Polymer Science /Rubber Technology/ Chemistry/ Physics/ /Biotechnology.

For admission in Ph.D. programme, the eligibility criteria is M.Tech in Chemical Engineering/Polymer Engineering, /Chemical and Polymer Engineering/Plastic Engineering/Rubber Technology/ Biotechnology/ Environmental Engineering/ Material Science and Engineering or M.Sc. in Polymer Science /Rubber technology/Material Science/Chemistry/ Physics/ Biotechnology.

Agenda 5: To consider the list of instruments for the department

The department proposed a number of instruments and equipments for the smooth functioning of department and list was placed in the meeting. The matter was discussed and members felt that the need of the following equipments/ instruments for the department in 1st phase

1. DSC	2. FTIR
3. Digital PH Meter,	4. Thermal Cycler,
5. Hot Air Oven,	6. Microcontroller,
7. Turbidity Meter,	8. Spectrophotometer,
9. Distilled Water Plant,	10. Vertical Autoclave,
11. Water Bath	12. Shaker,
13. Deep Freezer,	14. Laboratory Stirrer,
15. Laboratory Stirrer With Hot Plate,	16. Cooling Refrigerated Centrifuge,
17. Bacteriological Incubator,	18. Hot Plate,
19. Horizontal Laminar Flow,	20. Digital Weighing Balance,
21. Chiller	22. Sieve Shaker etc

Agenda 6: To prepare academic calendar for the department of Chemical and Polymer Engg.

The Committee members have approved the academic calendar with few minor changes.

Prof. Anjan Mukherjee (Pro-Vice-Chancellor)
Faculty of Mathematics & Chairman (Dean in- charge)
Tripura University

Copy to:

1. All BPGS members
2. The Dean, Faculty of Chemistry

3. P.S. to the Hon'ble Vic-Chancellor, TU
4. Assistant Registrar (academic), TU

Detailed Content of the Syllabus

1st Semester (600 Marks)

Code: CP 901C

**Name: Advanced Reaction
Engineering**

Credits: 4 Marks 100

- Reactor and reactor types, modes of reactor operation: growth kinetics, batch, fed-batch and continuous operation. Productivity optimisation and cost minimisation. Reactor design: size estimation, single or multiple vessels, impeller and sparger systems. Design for containment and aseptic operation. reactor monitoring and control: instrumentation, on-line and off-line analyses, control algorithms.
- Reactor sterilization: cell death kinetics, batch and continuous systems, filter sterilization of gasses and liquids, safe and contained operation. Oxygen transfer: mass transfer, design for oxygen transfer. Mixing and power consumption: power number and impeller design, mixing time and reactor heterogeneity, effect of aeration and broth rheology. Effects of shear during operation.
- Issues in process scale-up: effects of heterogeneity and bases for scale-up. Fermentation process scale down: benefits of process scale down. Biocatalyst kinetics and properties: enzyme immobilization, kinetics of free and immobilized enzymes, Industrial lectures on impact of microbial physiology on bioreactor performance, Present and future fermentation trends, Scale-up and scale-down of industrial fermentation processes, Rapid fermentation process development, Industrial applications.

Reference books:

1. Shuler, M. L. and Kargi, F., Bioprocess Engineering Basic Concepts, Prentice Hall, Englewood Cliffs, N. J., 2002.
2. Schugerl, K. and Bellgardt, K. V., Bioreaction Engineering: Modeling and Control, Springer Verlag, Heidelberg, 2000.
3. Blanch H. W. and Clark D. S., Biochemical Engineering, Dekker, 1996.
4. Doran P., Bioprocess Engineering Principles, Academic Press, New York, 1995.
5. Bailey J.E., and Ollis D.F., Biochemical Engineering Fundamentals, Second Edition, McGraw Hill, New York, 1986.
6. Molecular Biology of the Cell, Third Edition, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson, Garland Publishing Inc, N.Y., 1994.

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BFS of Science

7. Roger Harrison et al., Bioseparations Science and Engineering, Oxford University Press, 2003.

Code: CP 902C

Name: Polymer Science and
Technology

Credits: 4 Marks 100

Historical development of polymers.

Basic concepts and definitions: monomer, polymer, oligomer, repeating units, structural units, degree of polymerization, molecular weight.

Classification of polymers: natural vs. synthetic, linear, branched, cross-linked, amorphous, crystalline, thermoset, thermoplastic, homopolymer, co-polymer, fiber, plastics, elastomers.

Biopolymers, natural polymer and fibers: proteins, polynucleotides, polysaccharides, naturally occurring elastomers, natural and synthetic fibers, cellulose, non-cellulose.

Polymerization mechanism: introduction, chain polymerization, step polymerization, ionic and coordination polymerization, ring-opening polymerization.

Thermal transition in polymer: introduction, the glass transition temperature, molecular motion and glass transition, theories of glass transition and measurement of the glass transition temperature, factors affecting glass transition temperature, the crystalline melting point and the factors affecting the crystalline melting point.

Polymer additives and reinforcements: introduction, plasticizers, fillers and reinforcements, alloys and blends, antioxidants, thermal and UV stabilizers, flame-retardants, colorants, anti-static agents.

Mechanical properties of polymers: introduction, mechanical test (stress-strain, creep, stress relaxation, dynamic mechanical and impact experiments), stress-strain behavior of polymers, deformation of solid polymers, effects of structural and environmental factors on mechanical properties, polymer fracture behavior.

Polymer degradation and the environment: thermal degradation, oxidative and UV stability, chemical and hydrolytic stability, effects of radiation, mechanodegradation, management of plastics in the environment (recycling, incineration, biodegradation).

Textbooks

1. Principles of Polymerization, G. Odian (Wiley, London, 2004)
2. Polymer Science and Technology of Plastics and Rubber, P. Ghosh, Tata McGraw Hill, New Delhi, 2000.

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3. Polymer Science by Gowarikar, Johan wiley and Sons 1986.
4. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.
5. Textbook of Polymer Science, P. Nayak and S. Lenka, Kalyani Publishers, 1986.
6. Polymer Science and Technology by J. R. Fried, Prentice-Hall, Inc 1995.
7. Textbook of polymer Science and Engg., Anil Kumar and Gupta, tata McGraw-Hill publishing co, Ltd, 1978.
8. Plastics Materials J. A. Brydson, Butterworth Scintific, 1990.

Reference books

1. Fundamentals of Polymers: Raw Materials to Finish Products, Karak, N., PHI, New Delhi, 2009
2. Encyclopedia of Polymer Science and Engineering, Bikales, N. Overberger, C. G. Menges G., Wiley-Interscience, New York, 1989
3. Encyclopedia of Chemical Technology, Othmer, K., Wiley-Interscience, New York, 1992

Code: CP 903C

Name: Heat and Mass & Transfer

Credits: 4 Marks 100

Basics of heat transfer, modes of heat transfer and its defining equations, heat conduction through plane walls, hollow cylinder, hollow sphere and their three dimensional equations, combined modes of heat transfer, critical thickness of insulation, finite difference method for steady and unsteady conduction, heat transfer through extended surfaces, heat transfer through non-Newtonian fluids, concept of boundary layers, dimensionless numbers and their physical significance, free and forced convection, Boiling heat transfer, heat exchangers and its types, analogy of heat exchangers, heat exchanger design, radiation heat transfer, various radiation laws, Angle factor calculations, basics of mass transfer, diffusion, convective mass transfer, mass transfer theories, influence of turbulence on heat and mass transfer, mass transfer coefficients, absorption, distillation, humidification and air conditioning.

Text books

1. JP Holman: Heat Transfer, McGraw-Hill, New York.
2. Yunus A. Cengel : Heat Transfer - A Practical Approach, McGraw-Hill, New York.

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[Signature]
Dean and Chairman, BFS of Science,

3. M. Necati Ozisik: Boundary Value Problems of Heat Conduction; Dover Publications, New York.
4. P. S. Ghoshdastidar; Heat Transfer, Oxford University Press, UK.
5. Crank, J., and Park, G.S. (eds.), Diffusion in Polymers, Academic Press, New York (1968).
6. Richard G. Griskey, Mass Transfer in Polymer Systems, Springer
7. Kreith, F, Boehm R.F, Heat and Mass Transfer, CRC Press
8. Baehr HD, Stephan K, Heat and Mass Transfer, Springer

Code: CP 904C

Name: Polymer Lab

Credits: 2 Marks:50

1. Purification of monomers/solvent by distillation, crystallization of initiators, Free radical polymerization of MMA, MA, AA using BPO/AIBN initiators.
2. Synthesis of phenol formaldehyde (novolac and resole) resin, cross linking of phenolic resin, synthesis of poly (ethylene/terephthalate), synthesis of nylon-6,6.
3. Polymer end group analysis, determination of intrinsic viscosity and viscosity-average molecular weight of a given polymer sample, determination of number average molecular weight of a given polymer by vapor pressure osmometry, determination of molecular weight distribution by GPC.
1. Characterization of selected polymer sample by IR Spectrophotometer.
4. Determination of molecular weight & poly dispersity index (PDI) of given resin using GPC.
2. Determination of moisture content of given sample. (Quantitative analysis).

Textbooks

1. Purification of Laboratory Chemicals, Armarego, W.L.F. Chai, C.L.L., Elsevier, Burlington, 2009.
2. Experimental Methods in Polymer Science, Tanaka, T., Academic Press, Florida, 2000.
3. Experiments in Polymer Science, Collins, E.A. Bares, J. Billmeyer, Jr., F.W., (Wiley, New York, 1973)

Reference Books

1. Laboratory Preparation for Macromolecular Chemistry, MaCaffery, E.M., McGraw-Hill, New York, 1970.

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of Science.

2. Methods of Polymers Chemistry, Sorensen, W.R. Campbell, T.W. Preparative, Wiley, New York, 1968)
3. Polymer Chemistry: A Practical Approach, Davis, F.J., Oxford, London, 2004.

Code: CP 905C Name: Reaction Engineering Lab Credits: 2 Marks:50

Preparation and Sterilization of Industrial reactor Medium

1. Laboratory scale reactor operation and product separation
2. Growth kinetics measurement through spectrophotometer
3. Reactor based production of organic acids from synthetic medium
4. Optimization of reactor process parameters
5. Product preservation techniques

Text books

- 1) Biochemical Engineering and Biotechnology, Ghasem D. Najafpour, Elsevier, Amsterdam, The Netherlands
- 2) Bioprocess Engineering Principles, Pauline M. Doran, Academic Press, California. Elsevier India Private Limited, New Delhi
- 3) Bioprocess Monitoring and Control, By Marie- Noelle Pons, Hanser Publishers New York, USA
- 4) Biochemical Engineering By J.M. Lee, Prentice Hall, Englewood Cliffs, New Jersey
- 5) Biochemical Engineering, 2nd Edition, By S. Aiba, A.E. Humphrey & N.F. Millis, University of Tokyo Press, Japan
- 6) Biochemical Engineering Fundamentals 2nd Edition, By J.E. Bailey, D.F. Ollis, McGraw Hill Book Company, New Delhi

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Detailed syllabus for electives for 1st Semester

Code: CP906E Name: Rubber Science and Credits: 4 Marks: 100

Technology

Natural Rubber: source, isolation and processing of latex, various natural rubber grades and products, Chemistry of rubber and rubber additives, Compounding and vulcanization mechanism, chemistry of vulcanization, Degradation and aging of rubber, modification of rubber, theory of rubber elasticity, Rubber reinforcement, Synthetic rubbers: SBR, NBR, IR, IIR, CR, EPR, EPDM, Hypalon, fluoroelastomers, silicones, Thermoplastics, elastomers, structure property applications, Polyesters and ester urethane or ether-urethane rubbers, Rheometry and curometry, assessment of curing/degree of cure, rubber additives, sulphur vulcanization vs non sulphur vulcanization, cold curing, Copolymer composition determination through NMR, Details of the following rubber products: shoes, belting and hoses, cables, automobile tyres and tubes, etc.

References

1. Erman, B. Mark, J.E. Science and Technology of Rubber (Academic Press, Florida, 2005).
2. EIRI Board, Technology of Rubber & Rubber Goods Industries (Engineers India Research Institute, New Delhi, 2009).
3. Kothandaraman, B. Rubber Materials (Ane Books Pvt Ltd, New Delhi, 2008).

Code: CP907E Name: Colloids and Interface Credits: 4 Marks: 100

Science

Basic concepts of colloids and interfaces; properties of colloidal dispersions; surfactants and their properties; micelles, bilayers, vesicles and liquid crystals; surface and interfacial tension; Young-Laplace equation; Kelvin equation; contact angle; intermolecular and surface forces; DLVO theory; adsorption at interfaces; characterization of solid surfaces; applications in

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detergents, personal care products, pharmaceuticals, nanotechnology, and food, textile, paint and petroleum industries.

Textbooks:

P. C. Hiemenz and R. Rajagopalan, Principles of Colloid and Surface Chemistry, Marcel Dekker, New York, 1997.

J. C. Berg, An Introduction to Interfaces and Colloids: The Bridge to Nanoscience, World Scientific, Singapore, 2010.

P. Ghosh, Colloid and Interface Science, PHI Learning, New Delhi, 2009.

Code: CP908E Name: Polymer Recycling & Credits: 4 Marks: 100
Uses

Sources of plastic waste and its management, separation methods, primary & secondary recycling methods, tertiary and quaternary recycling, recycling methods of specific plastics (PVC, PET, PMMA, HDPE, LDPE, PS), characteristics and typical applications of few plastic materials.

Text Books:

1. J Leidner, Plastic Waste, Marcel Dekker
2. J Aguado & D Serrano, Feedstock Recycling of Plastic Waste, Royal Society of Chemistry
3. B Hegberg, G Brenniman, Mixed Plastic Recycling Technology, Noyes Data Corporation
4. L Mantia, Recycling of Plastic Materials, Chemtec Publishing
5. Harper, Modern Plastics Handbook, McGraw-Hill

2nd Semester (600 Marks)

Code: CP1001C Name: Advanced Fluid Flow & Credits: 4 Marks: 100
Rheology

Basic Concepts and Fundamentals: Definition and properties of fluids, fluid as a continuum, Lagrangian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics.

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Governing Equations of Fluid Motion: Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation.

Exact solutions of Navier-Stokes Equations: Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows.

Laminar Boundary Layers: Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Approximate Methods, Flow separation, Entry flow into a duct.

Turbulent Flow: Introduction, Fluctuations and time-averaging, General equations of turbulent flow, Turbulent boundary layer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtl mixing hypothesis, Turbulence modeling, Free turbulent flows.

Rheometry: Introduction, principles of viscometry, Rheometers and rheometrical procedures, Typical rheological behaviours, problems encountered in rheometry, Non-standard techniques: what can be done without a rheometer.

Text books

1. Morrison, F.A. 2001 *Understanding Rheology*. New York: Oxford University Press
2. Batchelor G.K, An Introduction to Fluid Dynamics, Cambridge University Press, 1983.
3. Fox W. Robert, McDonald T. Alan, Introduction to Fluid Mechanics, Fourth Edition, John Wiley & Sons, 1995.
4. Frank M. White, Fluid Mechanics, Tata McGraw-Hill, Singapore, Sixth Edition, 2008.
5. Barnes, H.A., Hutton, J.F., Walters, K.: An Introduction to Rheology. Rheology series, Vol. 3, Elsevier, 1989. F. Irgens: Compendium.
6. Bird, R.B., Armstrong, R.C. & Hassager, O. 1987 Dynamics of Polymeric Liquids. New York: John Wiley & Sons

Code: CP1002C Name: Polymer Characterization Credits: 4 Marks: 100 and Testing

Characterization tests: TGA, DTA, DSC, TMA, XRD, SEM, AFM, TEM, IR, NMR, GC, GPC melt index and viscosity.

Thermal and electrical properties: Heat deflection temperature, Vicat softening temperature, thermal conductivity thermal expansion, brittleness temperature – dielectric strength dielectric constant, dissipation factor, resistance.

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Mechanical properties and flammability: Tensile tests, compressive properties, impact properties, deformation, brittleness abrasion resistance hardness tests – incandescence resistance, ignition properties, oxygen index, surface burning characteristics.

Optical properties and analytical tests: Refractive index, luminous transmittance, haze, density, water absorption, moisture analysis, sieve analysis, crush and burst strength.

Testing of foam plastics and testing organizations: Foam properties, rigid and flexible foam - testing methods .

Text books

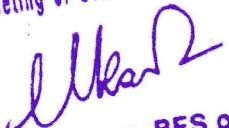
1. S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.
2. Vishu Shah, Hand book of Plastics Testing and Failure Analysis, 3rd Edition, John-Wiley & Sons, New York, 2007.
3. B. Sivasankar, Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2012
4. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., New Delhi, 2003
5. A. Ya. Malkin, A.A. AskaDsky, V.V. Koverica Experimental methods of polymers, Mir Publishers, Moscow, 1998.
6. Iver, Mead and Riley, Hand book of Plastic test methods, Illith Publishers, New York, 1982.

**Code: CP1003C Name: Polymer Characterization Credits: 2 Marks:50
lab**

1. Determination of melt flow index (MFI) of given sample.
2. Curing characteristic studies of different rubbers using different compounding ingredient by rheometer.
3. Thermal analysis of polymers by DSC, TGA, DMA.
4. Study rheological properties of polymers by rheometer.
5. Determination of stress-strain profile of polymers, determination of tensile strength, modulus and elongation at break of selected thermoplastics and natural rubber, determination of impact strength, dielectric constant.

Textbooks

Approved in BFS meeting of Science, T.U. dated 16.05.2017


Dean and Chairman, BFS of Science,
Tripura University.

1. Modern Technology of Plastic & Polymer Processing Industries, NIIR Board, National Institute of Industrial Research, New Delhi, 2007)

Reference Books

1. Polymer Testing, Grellmann, W. Seidler, S. Altstadt, V., Hanser Gardner PUBNS, Cincinnati, 2007.

Detailed syllabus for electives for 2nd Semester

Code: CP1004E Name: Polymer Processing Credits: 3 Marks: 100

Basic Concept of Compounding and Processing. Classification and type of Additive for Plastics: antioxidants, light stabilizers, UV stabilizers, lubricants and relative auxiliaries, processing aids, impact modifiers, flame retardance, fillers, crosslinking agents, antistatic agents, stabilizers and Plasticizers. Rheology of polymer melt. Mixing process: distributive mixing, dispersive mixing and mixing devices. Molding: injection molding, Extrusion molding, compression molding, transfer molding, reaction injection molding (RIM) , bow molding, rotational molding, film extrusion, pultrusion, calendaring, casting, coating, foaming, forming laminates. Fiber technology and processing: definition of textile terms, properties of textile fibers (electric, mechanical and fabric properties). Fiber spinning: melt spinning, dry spinning, and wet spinning. Fiber after treatments scouring, lubrication, sizing, dyeing, finishing. Elastomers technology and processing: Compounding and elastomers properties, Vulcanization: chemistry of vulcanization, sulfur vulcanization, physical aspects of vulcanization. Reinforcement, types of fillers, carbon black.

Textbooks

1. Plastics Engineering by R. J. Crawford, Pergamon Press 1989.
2. Understanding Compounding, R. H. Wildi and Maier, Hanser Publisher Inc, 1998.

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3. Fundamental of Polymer processing, S. Middleman, Houghton Mifflin Company, 1997.
4. Polymer Processing Fundamentals, Osswald, A. Tim, Hanser Publishers, 1998.
5. Composite Material Handbook, M. M. Schwartz, McGraw-Hill Company, 1984.
6. Principles of Polymer Processing, Tadmor, Z. Gogos, G.G., Wiley, New York, 2006.
7. Polymer Process Engineering, Grulke, E.A., PTR Prentice Hall, Eaglewood Chiffs, New Jersey, 1994.

Reference books

3. Advances in Polymer Processing: Macro to Nano Scales, Thomas, S. Yang, W., CRC press, Boca Raton, 2007.
4. Principles of Polymer Engineering, Mccrum, N.G. Buckley, C.P Bucknell, C.P, Oxford Engineering Press, Oxford, London, 1988.
5. Rheology and Processing of Polymeric Materials: Polymer Rheology, Han, C.D., Oxford University Press, New Delhi, 2006

Code: CP1005E Name: Fluidization Engineering Credits: 3 Marks: 100

Introduction to fluidization, types of fluidization, fluidized bed behaviour study, solid transport in fluidized bed, heat and mass transfer in fluidized bed, semi-fluidization principles, industrial applications of fluidization, design of fluidized bed reactor, Concept of RTD, Basic design principles for Fluidized bed reactor, use of fluidized bed reactors in polymer industries (catalytic olefin polymerization, polymerization reaction of ethylene and propylene etc.), Fluidized Bed Dryer (FBD)- Introduction, advantages and limitations of FBD, mathematical models, effect of operating parameters of FBD, design procedure of FBD,

Text Books:

1. Kunni&Levenspiel: Fluidization Engineering, Elsevier Publications,
2. W.C. Yang: Handbook of fluidization and fluid particle systems, Marcel Dekker, New York.
J.F Davidson, D. Harrison; Fluidized Particles, Cambridge University Press, Cambridge

Code: CP1006E

Name: Biomaterials

Credits: 3 Marks: 100

Approved in BFS meeting of Science, T.U. dated 26.10.2017

[Signature]

Chairman, BFS of Science,

Introduction to Biomaterials Concept of biomaterials, need for biomaterials for uses in medicine and scientific research, basic properties, clinical significance. Disinfection and sterilisation of biomaterials. Biocompatibility, Bioceramics: Structure and Synthesis, Properties and Characterization of Biomaterials, Implants and medical devices; Deterioration of biomaterials, Naturally Occurring Polymer Biomaterials, Metallic biomaterials and their application, Biomaterials for Tissue Engineering, Other Important Issues and Future Challenges in biomaterial engineering.

Text Books:

H.Boenig, Fundamentals of Plasma Chemistry and Tehnology, Technomic Publishing Co.Inc. Lancaster Basel, 1990.

Hench L LEthridgc E.C. Biomaterials, an interfacial approach, Academic press 1982

Practical Surface Analysis, 2- edition, Edited by D.Briggs, M.P.Seah, J.Wiley& Sons Ltd, 1990.

Biomaterials Science, An Intoduction to Materials in medicine, Eds. B. D. Ratner and A. S. Hoffman, Academic Press, New York, 1996.

Plasma-surface modification of biomaterials, P.K.Chua, J.Y.Chena, L.P.Wanga, N.Huang, Elsevier Science B.V, 2002.

Approved in BFS meeting of Science, T.U. dated 16/05/2017


Dean and Chairman, BFS of Science,
Tripura University.

1751
8-1-19

Respected back
Dept of Chemical and
Polymer Engineering
9/1/2017

Date: 8/1/18

To,
The Dean (Science),
Tripura University, Agartala

Subject: Requesting to send us the approved copy of the 1st BPGS proceedings of Dept. of Chemical and Polymer Engineering, Tripura University

Respected Sir,

The department of Chemical and Polymer Engineering at Tripura University conducted its 1st BPGS meeting on 7th March 2017 (Tuesday) at 1 PM in the chamber of the Head of the department of Chemical and Polymer Engineering. The details of the agendas discussed in that meeting and was later taken in the 2nd meeting of the 2nd Board of Faculty of Studies of Science (5th Meeting of BFS) held on 14.09.2016 in the Conference Hall, Tripura University at 1.30 p.m where it was provisionally considered and recommended to the Academic Council for approval.

We therefore request you kindly send us the approved copy of the 1st BPGS proceedings. A copy of the 1st BPGS proceedings is attached with this letter.

Yours Faithfully,

Harjeet Nath
8/1/18

Harjeet Nath
Assistant Professor
Dept. of Chemical and Polymer Engineering
Tripura University (A Central University)

Sachin Bhaladhare
8/1/18

Dr. Sachin Bhaladhare
Assistant Professor
Dept. of Chemical and Polymer Engineering
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Dr. Sachin Bhaladhare
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