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UNIVERSITY OF MYSORE

Estd.1916

Vishwavidyanilaya Karyasoudha
Crawford Hall, Mysuru- 570 005

(Re-accredited by NAAC at 'A')

(NIRF-2023 Ranked 44 in University Category & 71 in Overall Category)

No.: PMEB-1/Spl./10(2)/2023-24 **Date: 04-11-2024**

NOTIFICATION

Sub.: Syllabus and Examination pattern of **M.Sc. (Polymer Science)** course under Specialized Programme from the academic year 2024-25-reg.

Ref.: 1. Decision of the BOS Meeting held on 15-11-2023.
2. Decision of the Academic Council meeting held on 22-10-2024.

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The Board of Studies in **M.Sc. (Polymer Science) (PG)** at its meeting held on 15-11-2023 has resolved and recommended the Syllabus of **M.Sc. (Polymer Science)** course (CBCS Scheme) in University of Mysore under specialized/ specified programs from the academic year 2024-25.

The Academic Council has also approved the above said proposals at its meeting held on 22-10-2024 and the same is hereby notified.

The Syllabus of **M.Sc. (Polymer Science)** course may be downloaded from the University website **https://uni-mysore.ac.in/PMEB/.**

REGISTRAR
University of Mysore
MYSURU - 576

To,

1. The Registrar (Evaluation), University of Mysore, Mysuru.
2. The Dean, Faculty of Science & Technology, DoS in Mathematics, Manasagangothri, Mysuru.
3. Prof. K.N. Mohan, DoS in Chemistry, Manasagangothri, Mysuru.
4. The Principal, Central Institute of Petrochemicals Engineering and Technology (CIPET), # 437/A, Hebbal Industrial Area, Mysuru.
5. The Deputy Registrar/ Asst. Registrar/ Superintendent, Examination Branch, UOM, Mysuru.
6. The PA to Vice-Chancellor/Registrar/Registrar (Evaluation), University of Mysore, Mysuru.
7. Office Copy.

सिपेट CIPET

केंद्रीय पेट्रोरसायन अभियांत्रिकी एवं प्रौद्योगिकी संस्थान - मैसूरु

CENTRAL INSTITUTE OF PETROCHEMICALS ENGINEERING AND TECHNOLOGY(CIPET) : CSTS

Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Government of India

प्रशिक्षण विभाग / TRAINING DEPARTMENT

Date : 15.11.2023

Proceedings of the Board of Studies (BoS) meeting in M.Sc. Polymer Science (PG) held on 15.11.2023 from 10.00am to 5.00pm at CIPET – Mysuru, Conference hall.

Sl.No	Name	BoS Designated	Signature
1.	**Prof. K.N. Mohana** DoS in chemistry, University of Mysore (UoM) Manasagangothri, Mysuru	Chairman	15/11/23
2.	**Dr. S. Srikanth** Sr. Tech. Asst. (SG), CIPET, Hebbal Industrial Area, Mysuru	Member	
3.	**Mr. R. T. Nagaralli** Director & Head, CIPET, Hebbal Industrial Area, Mysuru	Member	15/11/23
4.	**Mrs. S. Bharathi** Manager (T), CIPET, Hebbal Industrial Area, Mysuru	Member	15/11/23
5.	**Mr. R. Judson Pray Chellam** Asst. Officer, CIPET, Hebbal Industrial Area, Mysuru	Member	15.11.23.
6.	**Dr. Manoranjan Biswal** Sr. Scientist, CIPET , SARP-APDDRL, Devanahalli, Bengaluru	External Member	15.11.2023
7.	**Dr. Wasim Feroze G.S.** Jr. Scientist, CIPET , SARP-APDDRL, Devanahalli, Bengaluru	External Member	15/11/23

Meeting began with the chairman welcoming all the members of BoS in M.Sc. Polymer Science.

AGENDA

1. The rules and regulations of University of Mysore (UoM) with regards to Choice Based Credit System (CBCS) was briefed by chairman.
2. The draft syllabus was restructured as per the rules and regulations.
3. The subjects were arranged as per the credit system stipulated.
4. The BoS members reviewed each topic for the subjects and necessary modifications were recommended.
5. The final syllabus will be submitted to the BoS chairman after modifications for the further process.

The meeting concluded by the chairman, thanking all the members.

6. List of Panel of examiners was prepared

7. Any Othermatter : NIL

Dr. K.N. Mohana

Dr. K. N. MOHANA, M.Sc., Ph.D.
Professor, Department of Chemistry
University of Mysore
Manasagangotri, MYSURU-570 006
Karnataka, INDIA

सिपेट CIPET

केंद्रीय पेट्रोरसायन अभियांत्रिकी एवं प्रौद्योगिकी संस्थान - मैसूरु

CENTRAL INSTITUTE OF PETROCHEMICALS ENGINEERING AND TECHNOLOGY(CIPET) : CSTS

Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Government of India

प्रशिक्षण विभाग / TRAINING DEPARTMENT

Date : 15.11.2023

Sub: Attendance of the Board of Studies (BoS) in M.Sc. Polymer Science (PG) meeting at CIPET:CSTS-Mysore – Reg.

Ref: CIPET/Mys/M.Sc./BoS/2023-24/01 Dated 08.11.2023.

Sl.No	Name	BoS Designated	Signature
1.	**Prof. K.N. Mohana** DoS in chemistry, Manasagangothri, Mysuru	Chairman	15/11/2023
2.	**Dr. S. Srikanth** Sr. Tech. Asst. (SG), CIPET, Hebbal Industrial Area, Mysuru	Member	
3.	**Mr. R. T. Nagaralli** Director & Head, CIPET, Hebbal Industrial Area, Mysuru	Member	15/11/23
4.	**Mrs. S. Bharathi** Manager (T), CIPET, Hebbal Industrial Area, Mysuru	Member	15/11/2023
5.	**Mr. R. Judson Pray Chellam** Asst. Officer, CIPET, Hebbal Industrial Area, Mysuru	Member	15.11.23.
6.	**Dr. Manoranjan Biswal** Sr. Scientist, CIPET , SARP- APDDRL, Devanahalli, Bengaluru	External Member	15.11.2023
7.	**Dr. Wasim Feroze G.S.** Jr. Scientist, CIPET , SARP- APDDRL, Devanahalli, Bengaluru	External Member	15/11/23

सिपेट CIPET

CENTRAL INSTITUTE OF PETROCHEMICALS ENGINEERING & TECHNOLOGY (CIPET)

Department of Chemicals & Petrochemicals,

Ministry of Chemicals & Fertilizers, Govt. of India

No. 437/A, Hebbal Industrial Area, Mysore – 570 016

Phone : 0821-2511903 Fax : 0821-2510990

Mobile: 9466146001

E-mail: **mysore@cipet.gov.in / cipetmys1@gmail.com**

Website: **www.cipet.gov.in**

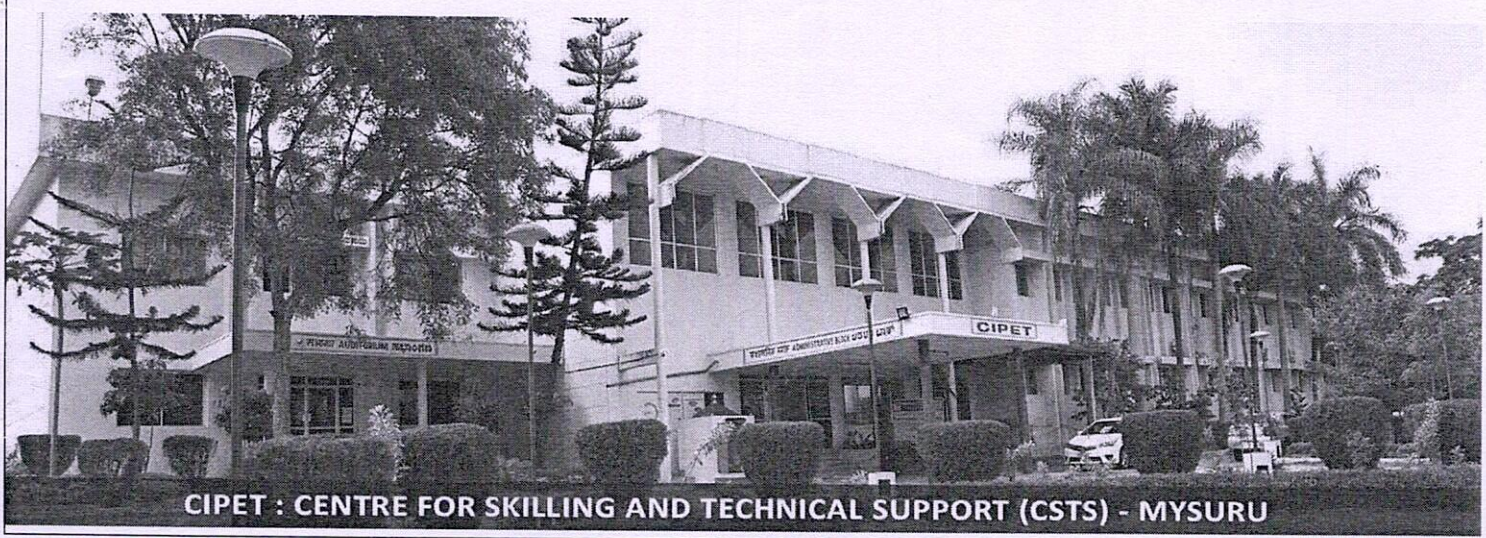
Regulations and Syllabus

University Of Mysore (UoM)

For

Specialized M.Sc. course under Choice Based Credit System (CBCS)

M.Sc. Polymer Science



CIPET : CENTRE FOR SKILLING AND TECHNICAL SUPPORT (CSTS) - MYSURU

Course Details

Sl. No.	Particulars	Details
1.	**Name of Institution & Address**	Central Institute of Petrochemicals Engineering and Technology (CIPET), #437/A, Hebbal Indl Area, Mysore - 570 016, Karnataka
2.	**Organization/Society/Trust details**	CIPET – Head Office, T.V.K.Industrial Estate, Guindy,Chennai-600032,TN
	Qualification Title	**M.Sc. Polymer Science**
4.	**Duration of the Course**	**2 years - divided into 4 semesters**
5.	**Nature and purpose of the qualification**	**Nature: Post Graduate Degree** **Purpose:** Learners who attain this qualification are competent in Plastics processing techniques like Injection Molding, Extrusion, Blow molding, compression molding, etc. and in testing of Plastic products and raw materials. The graduates can become entrepreneurs, executives in R&D organizations, Aerospace, Automobile, Electrical & Electronics, Medical industries etc.
6.	**Body/bodies which will award the qualification**	**University Of Mysore (UoM)**
7.	**Body/bodies which will carry out assessment of learners**	Central Institute of Petrochemicals Engineering and Technology (CIPET), Mysuru
8.	**The intake of seats**	**40**
9.	**Selection of Students**	CIPET Mysuru Entrance Exam
10.	**Entry requirements**	**Any Bachelor Degree** **(with Chemistry/Engg.Chemistry as one of the subject)**
11.	**Minimum Attendance requirement to attend Semester Examination**	**75%**
12.	**Occupation(s) to which the qualification gives**	Production Officer / Quality Control Officer / Supervisor
13.	**Progression from the qualification**	**Job Progression:** After completion of three semesters of theory and practical, students have to undergo six months industrial training cum project work with stipend and after the completion of training the graduates can work as a Production Officer or Quality Control Officer / Supervisor. After 5 years of experience they can become Production Manager/Quality Manager in the downstream Polymer/Processing industries.
14.	**Minimum Credits**	**76**

Director & Head, CIPET Mysuru

Chairman, BoS (M.Sc. Polymer Science)

Dr. K. N. MOHANA, M.Sc., Ph.D.
Professor, Department of Chemistry
University of Mysore
Manasagangotri, MYSURU-570 006
Karnataka, INDIA

Rules & Regulations

1. Definitions

Course Every course offered will have three components associated with the teaching-learning process of the course, namely:

(i) Lecture – **L** (ii) Tutorial- **T** (iii) Practicals - **P**,

where

L stands Lecture session. **T** stands Tutorial session consisting participatory discussion / self study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands Practice session and it consists of Hands on experience / Laboratory Experiments / Field Studies / Case studies that equip students to acquire the much required skill component.

In terms of credits, every one hour session of L amounts to 1 credit per semester and a minimum of two hour session of T or P amounts to 1 credit per semester, over a period of one semester of 16 weeks for teaching-learning process. The total duration of a semester is 20 weeks inclusive of semester-end examination.

2. Different courses of study are labeled and defined as follows:

Core Course

A course which should compulsorily be studied by a candidate as a core- requirement is termed as a Core course. A Core course may be a Soft Core if there is a choice or an option for the candidate to choose a course from a pool of courses from the main discipline /subject of study or from a sister/related discipline / subject which supports the main discipline / subject. In contrast to the phrase Soft Core, a compulsory core course is called a Hard Core Course.

Elective Course

Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline / subject of study or which provides an extended scope or which enables an exposure to some other discipline / subject/domain or nurtures the candidate's proficiency/ skill is called an Elective Course. Elective courses may be offered by the main discipline / subject of study or by sister / related discipline / subject of study. A Soft Core course may also be considered as an elective.

An elective course chosen generally from an unrelated discipline / subject, with an intention to seek exposure is called an open elective.

3. Eligibility for admission:

Candidates possessing a degree of University of Mysore, or of any other University, equivalent thereto and complying with the eligibility criteria are eligible for admission to Post-graduate degree programs.

4. Scheme of Instructions:

A Masters Degree program is of 4 semesters-two years duration. A candidate can avail a maximum of 8 semesters – 4 years (in one stretch) to complete Masters Degree (including blank semesters, if any). Whenever a candidate opts for blank semester(s)/DROP in a course or in courses or is compelled to DROP a course or courses as per the provision of the regulation, he/she has to study the prevailing courses offered by the department as per the prevailing scheme, when he/she continues his/her study.

A candidate has to earn a minimum of 76 credits, for successful completion of a Master's degree with a distribution of credits for different courses as given in the following table:

Course Type	Credits
Hard Core	A minimum of 42, but not exceeding 52
Soft Core	A minimum of 16
Open Elective	A minimum of 04

Every course including project work, practical work, field work, seminar, self study elective should be entitled as hard core or soft core or open elective by the BoS concerned

A candidate can enroll for a maximum of 24 credits per semester.Only such candidates who register for a minimum of 18 credits per semester in the first two semesters and complete successfully 76 credits in 4 successive semesters shall be considered for declaration of ranks, medals and are eligible to apply for student fellowship, scholarship, free ships and hostel facilities.

In excess to the minimum of 76 credits for masters degree in the concerned discipline / subject of study, a candidate can opt to complete a minimum of 18 extra credits to acquire add on proficiency diploma in that particular discipline / subject along with the masters' degree. In such of the cases wherein, a candidate opts to earn at least 4 extra credits in different discipline / subjects in addition to a minimum of 76 credits at masters level as said above then an add on proficiency certification will be issued to the candidate by listing the courses studied and grades earned.

A candidate admitted to Masters program can exercise an option to exit with Bachelor Honors degree / PG diploma after earning 40 credits successfully.

5. Continuous Assessment, Earning of Credits and Award of Grades

The evaluation of the candidate shall be based on continuous assessment. The structure for evaluation is as follows:

Assessment and evaluation processes happen in a continuous mode. However, for reporting purposes, a semester is divided into 3 discrete components identified as C1, C2, and C3.

The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below:

The first component (C1), of assessment is for 15 marks. This will be based on test, assignment and seminar. During the first half of the semester, the first 50% of the syllabus will be completed. This shall be consolidated during the 8th week of the semester. Beyond 8th week, making changes in C1 is not permitted.

The second component (C2), of assessment is for 15 marks. This will be based on test, assignment, seminar. The continuous assessment and scores of second half of the semester will be consolidated during the 16th week of the semester. During the second half of the semester the remaining units in the course will be completed.

The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) will be proposed by the teacher(s) concerned before the commencement of the semester and will be discussed and decided in the respective Departmental Council. The students should be informed about the modalities well in advance. The evaluated courses/assignments during component I (C1) and component II (C2) of assessment are immediately returned to the candidates after obtaining acknowledgement in the register maintained by the concern teacher for this purpose.

During the 18th -20th week of the semester, a semester-end examination of 2 hours duration shall be conducted for each course. This forms the third/final component of assessment (C3) and the maximum marks for the final component will be 70.

6. Setting questions papers and evaluation of answer scripts.

Questions papers in three sets shall be set by the internal examiner for a course. Whenever there are no sufficient internal examiners, the chairman of BoE shall get the questions papers set by external examiners. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation.

There shall be single valuation for all theory papers by internal examiners. In case, the number of internal examiners falls short, external examiners may be invited.

The examination for Practical work/ Field work/Project work will be conducted jointly by two internal examiners. However the BoE on its discretion can also invite external examiners if required.

If a course is fully of (L=0):T(P=0) type, then the examination for C3 Component will be as decided by the BOS concerned.

Challenge valuation : A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days after the announcement of the results. This challenge valuation is only for C3 component. The answer scripts for which challenge valuation is sought for shall be sent to another external examiner. The marks awarded will be the higher of the marks obtained in the challenge valuation and in maiden valuation.

In case of a course with only practical component a practical examination will be conducted with two examiners. A candidate will be assessed on the basis of a) knowledge of relevant processes b) Skills and operations involved c) Results / products including calculation and reporting. If external examiner does not turn up then both the examiners will be internal examiners. The duration for semester-end practical examination shall be decided by the departmental council.

If X is the marks scored by the candidate out of 70 in C3 in theory examination, if
Y is the marks scored by the candidate out of 70 in C3 in Practical examination, and if Z is the marks scored by the candidate out of 70 in C3 for a course of (L=0):T:(P=0)type that is entirely tutorial based course, then the final marks M in C3 is decided as per the following table:

L.T.P distribution	Find mark M in C_3
L:T:P	$\frac{[(L+T)*X]+[(T+P)*Y]}{L+2T+P}$
L:(T=0):P	$\frac{(L*X)+(P*Y)}{L+P}$
L:T:(P=0)	X
L:(T=0):(P=0)	X
(L=0):T :P	Y
(L=0): (T=0):P	Y
(L=0): T:(P=0)	Z

The details of continuous assessment are summarized in the following table:

Component	Syllabus in a course	Weightage	Period of Continuous assessment
C_1	First 50% (2 units of total units)	15%	First half of the semester. To be consolidated by 8th week
C_2	Remaining 50% (Remaining units of the course)	15%	Second half of the semester. To be consolidated by 16th week
C_3	Semester-end examination (All units of the course)	70%	To be completed during 18th-20th Week.
Final grades to be announced latest by 24th week			

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (15 + 15 + 70).

Finally, awarding the grades should be completed latest by 24th week of the semester.

7. Minor/ Major Project Evaluation

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the guide. Components of evaluation are as follows.

Component – I(C1): Periodic Progress and Progress Reports (15%)

Component – II(C2): Results of Work and Draft Report (15%)

Component– III(C3): Final Viva-voce and evaluation (70%). The report evaluation is for 40% and the Viva-voce examination is for 30%.

In case a candidate secures less than 30% in C1and C2 put together in a course, the candidate is said to have DROPPED that course, and such a candidate is not allowed to appear for C3 in that course.

In case a candidate's class attendance in a course is less than 75% or as stipulated by the University, the candidate is said to have DROPPED that course, and such a candidate is not allowed to appear for C3 in that course. Teachers offering the courses will place the above details in the Department Council meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Chairman of the Department before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

In case a candidate secures less than 30% in C3, he/she may choose DROP/MAKE- UP option.

In case a candidate secures more than or equal to 30% in C3, but his/her grade (G) = 4, then he/she may be declared to have been conditionally successful in this course, provided that such a benefit of conditional clearance based on G=4 shall not be availed for more than 8 credits for the entire programme of Master's Degree of two years.

In case a candidate secures less than 30% in C3, he/she may choose DROP/MAKE-UP option. The candidate has to exercise his/her option to DROP immediately within 10 days from the date of notification of results.

A MAKE UP examination for odd semester courses will be conducted along with next regular odd semester examinations and for even semester courses along with a next regular even semester examinations. If a candidate is still unsuccessful, he/she may opt for DROP or again take up MAKE UP examination; however, not exceeding double the duration norm in one stretch from the date of joining the course.

A candidate has to re-register for the DROPPED course when the course is offered again by the department if it is a hard core course. The candidate may choose the same or an alternate core/elective in case the dropped course is soft core / elective course. A candidate who is said to have DROPPED project work has to re-register for the same subsequently with in the stipulated period. The details of any dropped course will not appear in the grade card.

The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. This statement will not contain the list of DROPPED courses.

Upon successful completion of Bachelors Honors / Masters degree a final grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

The grade and the grade point earned by the candidate in the subject will be as given below:

Marks	Grade	Grade Point (GP = V x G)
30-39	4	V*4
40-49	5	V*5
50-59	6	V*6
60-64	6.5	V*6.5
65-69	7	V*7
70-74	7.5	V*7.5
75-79	8	V*8
80-84	8.5	V*8.5
85-89	9	V*9
90-94	9.5	V*9.5
95-100	10	V*10

Here, P is the percentage of marks (P=[(C1+C2)+M] secured by a candidate in a course which is rounded to nearest integer. V is the credit value of course. G is the grade and GP is the grade point.

A candidate can withdraw any course within in ten days from the date of notification of final results. Whenever a candidate withdraws a paper, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective.

A DROPPED course is automatically considered as a course withdrawn.

Overall cumulative grade point average (CGPA) of a candidate after successful completion the required number of credits (76) is given by:

CGPA = ΣGP / Total number of credits

8. Classification of results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows:

CGPA	FGP	
	Numerical Index	Qualitative Index
4 <= CGPA < 5	5	SECOND CLASS
5 <= CGPA < 6	6	
6 <= CGPA < 7	7	FIRST CLASS
7 <= CGPA < 8	8	
8 <= CGPA < 9	9	DISTINCTION
9 <= CGPA <=10	10	

Overall percentage=10*CGPA or is said to be 50% in case CGPA<5

9. Medium of Instruction

The medium of instruction shall be English. However, a candidate will be permitted to write the examinations either in English or in Kannada. This rule is not applicable to languages.

10. Provision for appeal

If a candidate, is not satisfied with the evaluation of C1 and C2 components, he / she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

Eligibility for Admission to M.Sc Polymer Science:

Any Branch Graduates (with Chemistry / Engg. Chemistry as one of the subject)

Syllabus for Entrance Examination

Unit 1: History of macro molecular science, importance of monomers and polymers, basic concepts. Nomenclature of polymers, inter molecular forces and chemical bonding in polymers. Classification: addition polymerization, condensation polymerization, polymerization mechanism.

Unit 2: Techniques of polymerization: Bulk, solution, suspension, emulsion, co-ordination polymerization, ring-opening polymerization, co-polymerization, importance of molecular weight in polymers, molecular weight distribution, control of molecular weight and their determination.

Unit 3: Bonding in organic molecules- Hybridization, sigma, pi and conjugated bonds, taking ethane, 8thane, ethyne, Butadiene and benzene as examples. Bond energy, bond length and bond angles. Concept of resonance, resonance energy.

Unit 4: Stereochemistry: Chiral concepts, D, L; R, S nomenclature. Geometrical isomers: E and Z nomenclatures, Classification of organic reagents and reactions: Nucleophiles, electrophiles, nucleophilicity and electrophilicity. Mechanism of SN1 and SN2 reactions, carbonium ions, carbanions and free radicals formation and stability.

Unit 5: Addition to carbon carbon double bonds, catalytic hydrogenation. Naming reactions like Aldol condensation, Claisen condensation, Grignard reaction, Beckmann rearrangement.

Unit 6: Thermodynamics: Laws of thermodynamics, spontaneous and non-spontaneous reactions. Gibbs free energy, relation between entropy and thermodynamic probability. Partition functions. Partial molar quantities: partial molar free energy. Thermodynamics of dilute ideal and non-ideal solutions.

Unit 7: Chemical kinetics: Transition state theory. Reaction in solution: collusion theory and transition state theory. Salt effects. Effect of pressure and dielectric constant on reaction rates. Electro chemistry: Debye-Huckel theory of strong electrolytes, Onsager equation, Debye- Huckel limiting equation for activity coefficient, electrical double layer, electro capillary and electro kinetics phenomena.

Unit 8: Chemical bonding in inorganic compounds, coordination compounds, catalysis, aqueous and non aqueous solutions, s, p, d, molecular orbitals and their shapes. Heisenberg uncertainty principle. Atomic orbitals, Schrodinger wave equations, Quantum numbers, Aufbu and Pauli Exclusion Principle, Hund's multiplicity rule, electronic configuration of the elements. Atomic and ionic radii, ionization energy, electron affinity and electro negativity.

Unit 9: Chromatography: general terms and parameter used in chromatography, classification of chromatographic methods. Stationary and mobile phases- nature of adsorbents, factors influencing the adsorbents, nature and types of mobile phases. Column chromatography and thin layer chromatography: principle and applications.

Unit 10: Need for testing, standard and specifications. National and international standards, quality control, accuracy and validity of best methods. Recycling and biodegradability methods.

References:

1. Chemical kinetics – K. J. Laidler
2. Thermodynamics- Kuriacose and Rajaram
3. Thermodynamics- S. Glasstone
4. Advanced Inorganic chemistry by J E .Huheey.
5. Advanced Inorganic chemistry by FA Cotton and G.Wilkinson
6. Organic chemistry- Morrison and Boyd (Prentice Hall)
7. Text Books of Polymer Science – Bill Meyer (Wiley Inter Science Publishers)
8. Polymer Science – V R Gowarikar

Syllabus for M.Sc Polymer Science

Semester I

Paper Code	HC/SC/OE	Subject	Credits			Total Credits
			L	T	P	
MS11	HCT	Polymer Chemistry and Polymeric Materials	4	0	0	4
MS12	HCT	Polymer Compounding	4	0	0	4
MS13	HCP	Polymer Chemistry Practicals	0	0	4	4
Any two given below						
MS14	SCT	Physical chemistry of polymers	4	0	0	4
MS15	SCT	Inorganic & Natural Polymers	4	0	0	4
MS16	SCT	Nano Science	4	0	0	4
MS17	SCT	Chemistry of High Polymers	4	0	0	4
Semester GPA						**20**

Semester II

Paper Code	HC/SC/OE	Subject	Credits			Total Credits
			L	T	P	
MS21	HCT	Plastics Testing	4	0	0	4
MS22	HCT	Plastics Processing Techniques	4	0	0	4
MS23	HCP	Plastics Testing and Processing Practicals - I	0	0	4	4
Any two given below						
MS24	SCT	Structure – Property relationship in polymers	4	0	0	4
MS25	SCT	Polymer Physics	4	0	0	4
MS26	SCT	Surface Coating & Adhesion Technology	4	0	0	4
MS27	SCT	Polymer Membrane & Drug Delivery	4	0	0	4
Semester GPA						**20**

HCT - Hard core Theory
HCP - Hard core Practicals
SCT - Soft core Theory

Semester III

Paper Code	HC/SC/OE	Subject	Credits			Total Credits
			L	T	P	
MS31	HCT	Advanced Polymeric Materials	4	0	0	4
MS32	HCT	Polymer Characterization	4	0	0	4
MS33	HCP	Plastics Testing and Processing Practicals - II	0	0	4	4
Any two given below						
MS34	SCT	Environmental Science and Plastics Waste Management	4	0	0	4
MS35	SCT	Polymers Blends & Composite	4	0	0	4
MS36	SCT	Adhesive materials	4	0	0	4
MS37	SCT	Rubber Technology	4	0	0	4
Semester GPA						**20**
Any one given below (for Non-Polymer students)						
MS34	OET	Environmental Science and Plastics Waste Management	4	0	0	4
MS38	OET	Plastics Product and Mould Design	4	0	0	4

Semester IV

Paper Code	HC/SC/OE	Subject	Credits			Total Credits
			L	T	P	
MS41	HCI	Internship / In plant training (Industry or Research Institutes)	0	1	3	4
MS42	HCD	Dissertation / Project Work (Industry or Research Institutes)	0	2	6	8
Open Elective						
MS43	OET	Any recognized course Certificate (Online/Offline)	4	0	0	4
Semester GPA						**16**

OET - Open Elective Theory
HCI - Hard core Internship
HCD - Hard core Dissertation

PROGRAMME OBJECTIVES

The main objective of this M.Sc., programme is to furnish strong foundation in the subject Polymer Science to become:

- Teaching faculties in Academic Institutions.
- Researchers in research institutions or industries.
- Entrepreneur to start their own company.

PROGRAMME OUTCOMES

The M.Sc., programme in Polymer Science is highly required programme among Material Science in the University. On successful completion of this programme each student will:

- Have a strong foundation in understanding the basic chemical and polymer reactions that occurs in both macro molecular and micro molecular systems at molecular level. Further the student will be able to learn cutting edge technology in the field of polymer science and technology, molecular biology, physical chemistry, inorganic, organic, physics , pharmaceuticals , engineering, medical and biomedical , space engineering , paramedical , paints, coatings, rubber Technology, fiber technology.
- Develop practical skills along with their theory components, which will help in their research programme both in academic institutions and in R & D programme of industries.
- Inculcate skills for teaching in academic institutions and industries.
- Develop confidence in taking competitive examination in the field of material science both in India and abroad so that they can pursue higher education.

PROGRAMME SPECIFIC OUTCOMES

1. Get hands on experience in various aspects of plastics technology viz. plastic materials manufacturing, properties, applications, processing, product design, mold design, testing & quality control and recycling.
2. Take up responsibilities in production, testing, design and marketing in the plastics industries and contribute for the growth of industry.
3. Acquire ability to become entrepreneurs as they can easily start up processing, compounding, design and marketing units.

PEDAGOGIES EMPLOYED IN THE COURSE

- Class room teaching will be using black board and chalk, power point presentation and information and communications technology.
- One on one interaction in tutorial classes.
- Individual student performs experiments as per the protocol in practical classes.
- Student seminar/research paper presentation in each semester.
- Students will be tested for their writing abilities to answer precise and essay type questions.
- Every semester the students will be subjected to viva - voce examinations by external examiners.
- Project work on a small research problem.
- Literature review in the form of Dissertation.
- Invited talks from eminent scientists.
- Industrial visit in every semester or every year
- Job placement for all the students in suitable industries.

Semester I

POLYMER CHEMISTRY AND POLYMERIC MATERIALS

Sub.Code:MS11
Paper: HCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the fundamental concepts of polymer chemistry.
- To study the structure of monomers, functionality, and classification of polymers based on source, composition, conditions, molecular weight, geometry, and Nomenclature of polymers.
- To study the various methods and techniques of polymerization reactions, their chemistry, mechanism, structures, properties and applications.
- To study the polymers as materials by comparison of plastics with conventional materials like metals, alloys, ceramics.
- To study the classifications of plastics like thermo plastics, thermo sets, elastomers and fibers.

Course Outcome

The student will be able to:

- Realize the basic concept of chemical reactions and polymerization reactions involved in the Macro molecules and micro molecular reactions
- Become fully aware of the stereo chemistry and physical status of polymer molecules, molecular weight, stereo specificity and stability of polymer compounds.
- Understand the study of methods of polymerization reaction and their properties, advantages, disadvantages, modifications and applications.
- Understand the polymer material classification of plastic materials.
- Compare plastic with convention materials.
- Become fully aware of thermoplastic, thermoset and elastomeric materials.

Course Content (List A)

(Total session: 32 hours)

UNIT-I: General introduction to polymers with emphasis on important concepts such as monomers, precuations and synthesis of monomers, functionality and physical state (amorphous and crystalline), classification of polymers on the basis of source, elemental composition, heat, pressure, chemical reactivity, Chemical/monomer composition, geometry and stereo regularity. Concept of molecular weight, Nomenclature of Polymers. 08h

UNIT-II: Chemistry and mechanism of Polymerization - Polymerization, Factors affecting on polymerization, Addition polymerization (free radical, ionic and co-ordination polymerizations), Condensation polymerization-molecular weight in step growth polymerization, Ring opening polymerization. Redox Polymerization, Radical polymerization, Co- polymerization, Co-polycondensation (with examples). Plasma polymerization, Photo polymerization, Electro chemical Polymerization, Metathesis polymerization, Group transfer polymerization- synthesis and applications. 08h

UNIT-III: Reactions of synthetic polymers -chemical modification; preparation of polymer derivatives, Macromers in polymer synthesis. Isolation and purification of Polymers, Polymer fractionation: Fractional precipitation technique, Partial Dissolution (extraction) technique. 08h

UNIT-IV: Methods of Polymerization – Bulk, solution, Suspensions, emulsion, melt polycondensation, interfacial polymerization, solution Polycondensation, solid phase, gas phase and (formulation, mechanism, properties of the polymer produced advantages and disadvantages of each technique). 08h

Reference (List A)

1. Introduction to polymers - R.J.Young & P.A.Lovell, Chapman & Hall, London. second edition. wiley online library 1991.
2. Text book of Polymer Science - Fred W.Billmeyer, J.R.John Wiley & Sons, New York. Third edition. wiley online library 1994.
3. Principles of Polymer Systems - F. Rodrignek, McGraw Hill, N.Y. 2nd edition. wiley online library 1981.
4. Polymer Chemistry - Seymour & Carreher, Marcel Dekkar, NY. Library of congress.
5. Principles of Polymerization - Odian G. ,4th edition. Wiley Inter Science, New Delhi
6. Polymer Science - V. R Gowarikar, Wiley Eastern Ltd. New Delhi. John wiley & sons. 1986.
7. Fundaments of Polymer Science and Engineering - Anil Kumar & S.K.Gupta, Tata Mc Graw Hill, New Delhi. 1978.
8. Introduction to polymer chemistry, G.S. Mishra, Wiley Eastern Ltd., New Delhi. Newage publishers 1993.
9. Principle of polymer science-P Bahadur, N.V Sastry 2nd edition Narosa Publishing House. 2002.
10. Polymers: Chemistry &Physics of Modern Materials-J.M.G. Cowie-Nelson Thornes Ltd. 1990
11. Preparation methods of polymer chemistry-Wayne. R. Sorenson, Fred Sweeny, Tod. W. Campbell.-A John Wiley & son, INC., Publication. 2001.
12. F.W. Billmeyer, Text Book of Polymer Science, 3rd edition, John Wiley and sons, New York,2002.
13. Gorge Odeon – Principles of Polymerization, 4th edition, McGraw Hill Book Company, New York 2004.
14. M.S.Bhatnagar, "A Text Book of Polymers (Chemistry and Technology of Polymers), Vol I, II & III, 1stEdn.,S.Chand and Company, New Delhi, 2007
15. PremamoyGhosh ," Polymer Science and Technology, 2ndedition,McGraw-Hill Publishing
16. R.J. Young, Introduction to Polymers, Chapman and Hall Ltd., London, 1999.

Course Content (List B)

(Total session: 32 hours)

UNIT-I: Introduction- polymers as materials, comparison of plastics with conventional materials like metals alloys ceramics etc. Classification of polymers / plastics, structural aspects, manufacture properties and applications 08h

UNIT-II: Thermoplastics- Polyolefins and allied polymers, Vinyl polymers - Styrene and its copolymers, Acrylics. Polyamides, Polyesters, Polyurethane, Fluoropolymers, Cellulose and its derivatives, Polycarbonates, Polyacetals, polyethersulfone, Polyethyleneimine, Polyether ether ketone Polyacrylic acid, Polyvinyl alcohol & Polyvinylacetals. 08h

UNIT-III: Thermosets- Phenol formaldehyde, Melamine formaldehyde, Urea-formaldehyde, Epoxy resins, Unsaturated polyester, Vinyl esters, Cyanate esters, Furan resins and silicone polymers. 08h

UNIT-IV: Elastomers- Natural Rubber, isoprene rubber, butyl rubber, Nitrile rubber, chloroprene rubber (CR) and Styrene-butadiene Rubber(SBR) Ethylene propylenediene monomer, Vulcanization, Rubber chemicals. 08h

Reference (List B)

1. Plastic materials 7th Edition –Brydson.-Elsevier 1965.
2. Rubbery materials and their compounds – Brydson.- Elsevior Applied Science.1988
3. Rubber technology and manufacture – C.M. Blow. .- Institution of Rubber Industry.2011
4. High performance polymers, their origin and development- R.B. Seymour and G.S. Krishenbaum. -Elsevier 1986.
5. Hand book of plastics materials and technology – Rubin. .-Wiley-Inter Science1990.
6. Plastics in Packaging – A.S.Athalye (Tata Mc Graw - Hill Publishing company, New Delhi).1992
7. Polymer science- V.R Gowrikar, N V Viswanathan, Jayaadev Sreedhar-New age International Publishers.1986
8. Polymer A Property Data Base-Bryan ellis, Ray Smith- CRS Press.1999
9. J.A.Brydson, "Plastics Materials", Butterworth- Heinemann - Oxford, 6th Ed., 1995.
10. Feldman.D and Barbalata.A, "Synthetic Polymers", Chapman Hall, 1996.

POLYMER COMPOUNDING

Sub.Code: MS12
Paper: HCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To impart the knowledge of compounding and mixing processes for the polymers and to study various mixing devices from the point of view of optimization of mixing time and power consumption.
- To study Processing additives & Compounding.

Course Outcome

The student will be able to:

- Realize various methods of compounding
- Understand about the tools, equipments, machines, and instruments related to Polymer industry.

Course Content

(Total session: 64 hours)

UNIT-I: Introduction – Need for compounding. Properties and technical requirements of additives. Compounding additives – Classification, role, mechanism, suitability and examples of additives - Limitations of raw polymer (plastics and elastomers) materials - Additives which assist processing – stabilizers, lubricants-properties, mode of action of lubricants and, their application in the processing. The technical and economic significance of lubricants and processing aids. Additives which modify mechanical properties – plasticizers- definition of term, solvency and Gelation properties, effects on hardness, tensile strength, elongation, low temperature resistance and electrical resistance. Reinforcing fillers, toughening agents or impact modifiers. 16h

UNIT-II: Processing additives: History of processing additives, Function of processing additives, Classification of processing additives, processing with plasticizer. Additives which reduced formulation costs – fillers-theory of the action of fillers and reinforcements, properties of filled and reinforced plastic, application criteria for fillers in thermoplastics, extenders - Additives modifying

surface properties – anti- static agents-chemical structure of anti-static agents, application, measurements of the anti-static agents, anti wear additives, adhesion promoters, anti-slip additives.16h

UNIT-III: Additives which modify optical properties – colorants-white pigments, carbon blacks, pigments, organic color pigments, optical brighteners. Anti-aging additives, anti-oxidants, auto-oxidation and mechanisms of anti-oxidation action, antioxidants, mechanisms of U.V stabilization-UV absorbers, quenches, hydroperoxide decomposers, free radical scavengers, Other additives, light stabilizer, accelerated weathering, outdoor weathering, influence of pigments on light stabilizer performance, blowing agents, flame retardant, specialty additives. Vulcanizing agents, vulcanization and its effects, vulcanization reaction stages, determination of state of vulcanization, vulcanization systems 16h

UNIT-IV: Compounding – criterion, costs- quality balancing, analysis of quality costs, quality cost elements, prevention cost, appraisal costs, internal costs, external failure cost. Compounding procedures for different polymers and products. Curing characteristic. - Compounding machineries and parameters – Mixing technology: principle of mixing, quality control. Different types of mixing roll mills, Internal mixers and solution mixers, mixing sequence on a two roll mill, mixing sequence in the internal mixer. Purging compounds. 16h

Reference

1. Plastic materials and processing – Brydson.1999
2. Rubbery materials and their compounds – Brydson.-Elsevior Applied Science.1988
3. Rubber technology and manufacture – C.M. Blow.- Institution of Rubber Industry.1971
4. Rubber technology – Morice Morton.-Springer-Science+.1973
5. Plastic additives handbook – Gachter /Muller.-Carl Hanser Verlag GmbH & Co 1990.
6. Handbook of plastic materials and technology – I I Rubin.-Wiley Inter Science 1990
7. PVC technology 4th Edition – Titow W. V.-Elsevier Applied Science.1985
8. Plastic additives and modifiers hand book – Van Nostrand Reinhold.-Springer 1992.
9. Design Formulas for Plastics Engineers- Natt S,Rao- Hanser publishers. NY.2004
10. Rubber Engineering- IRI- TMH Publishing company limited.1998
11. Plastic additives handbook- stabilizers, processing aids, plasticizers, fillers reinforcements, colorants for thermoplastics – R. Gachter and H. Muller- Hanser publishers, Munich Vienna New York. 1988.
12. Introduction of polymer science & rubber technology (volume 1)- Dr. R.Mukhopadhyay-Indian Rubber Institute.
13. Plastic additives handbook- stabilizers, processing aids, plasticizers, fillers reinforcements, colorants for thermoplastics (3rd edition) – R. Gachter and H. Muller- Hanser publishers, Munich Vienna New York. 1993.
14. R. Gachter and H. Muller, Plastics Additives Hand Book, Hanser Publishers, Munich, 1993.
15. John Murphy, The Additives for Plastics Hand Book, Elsevier Advanced Technology, Oxford, 1996.
16. Jesse Edenbaum, Plastics Additives and Modifiers Hand Book, Chapman & Hall, London,1996.
17. Ica Manas - Zloczower and Zehev Tadmor, Mixing and Compounding of Polymers, Hanser Publications, Munich, 1995.
18. Nicholas P. Cheremisionoff, Polymer Mixing and Extrusion Technology, Marcel Dekker Inc. NewYork, 1995.
19. J.A.Brydson, Plastics Materials, Butter worth Heinemann, Oxford, 1999.

POLYMER CHEMISTRY PRACTICALS

Sub.Code:MS13
Paper: HCP
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To determine polymerization reactions, their chemistry, mechanism, structures, properties and applications.
- To synthesis/fabricate these materials in lab scale.

Course Outcome

The student will be able to:

- Determine Polymer material properties.
- Synthesis the polymer material in lab.
- Become fully aware of thermoplastic, thermoset and elastomer material.

List of experiments (List A)

(Total session: 64 hours)

1. Determination of Molecular Weight by viscosity method.
2. Determination of rate constant for the hydrolysis of an ester.
3. Verification of Beer's law to determine the concentration of a given substance in solution using Photoelectric colorimeter.
4. Determination of molar heat of solution of sparingly soluble organic acid by solubility method.
5. Determination of equivalent conductance of strong electrolytes.
6. Conductometric titration of mixture of HCl, CH_3COOH and $CuSO_4$ against NaOH.
7. Comparison of strengths of acids by studying the kinetics of hydrolysis of an ester.
8. Kinetics of reaction between potassium per sulphate and potassium iodide (I and II orders).
9. Conductometric titration of sodium sulphate against barium chloride.
10. Determination of dissociation constant of a weak acid by conductivity method.
11. Potentiometric titration of a redox reaction involving potassium iodide and Potassium permanganate.
12. Redox polymerization synthesis: preparation of poly (acrylamide) by free Radical polymerization.
13. Precipitation polymerization of acrylonitrile.
14. Suspension polymerization of methyl methacrylate.
15. Emulsion polymerization of methylmethacrylate, polyacrylonitrile.

Reference (List A)

1. Experimental in polymer science -D.G. Hundiwale, V.D. Athawale, U. R. Kapadi, V.V.Gite., New age International (P) Limited, Pubilishers 2009.
2. Experiments in physical chemistry- James and Pritchard.
3. Selected experiments in physical chemistry-Latham
4. Experimental inorganic/physical chemistry-M. A. Malathi- Horwood publishing chichester, England 1999.
5. Preparative method in polymer science- Wayne R. Sorenson, Tod W. Campbell.
6. Practical physical chemistry- A Findlay, 2018
7. E. M. Mc Caffery, Laboratory Preparation for Macromolecular Chemistry, McGraw Hill,
8. Kogakush 1970.
9. Edward A. Colloid, J. Bares and F.W. Billmeyer Jr., Experiments in Polymer Science, Wiley

Interscience, New York 1973.
10. Tim A. Oswald Georg Menges "Material Science of Polymers for Engineers", Hanser Publications, 2012.
11. Wayne R. Sorenson and T. W. Campbell, Preparative Methods of Polymer Chemistry 3rd edition, Wiley – Interscience, New York, 2001.

List of experiments (List B)

(Total session: 64 hours)

1. Preparation phenol-formaldehyde resin.
2. Preparation of urea-formaldehyde by polycondensation method.
3. Preparation of polyacrylonitrile.
4. Preparation of glyptal resin.
5. Preparation of aniline formaldehyde by polycondensation method.
6. Preparation of polyacrylamide by free radical polymerisatiom.
7. Preparation of polyacrylic acid from acrylic acid monomer.
8. Acetylation of polyvinyl alcohol (PVA) to polyvinyl acetate (PVAc).
9. Preparation of polymethyl methacrylate by emulsion polymerisation.
10. Radical copolymerization of styrene and methylmethacrylate.
11. Copolymerization of styrene with Methyl methacrylate (MMA) by free radical solution technique.
12. Preparation of cellulose acetate.
13. Grafting of starch/cellulose with methylmethacrylate by redox initiator.
14. Chlorination/chlorosulphonation of Polyethylene (PE)
15. Film casting from polymer solution
    (A) Polyurethane (PU) (B) cellophane (C) cellulose acetate.
16. Bulk polymerization of styrene with benzoyl peroxide.
17. Preparations of diglycidyl ether bisphenol-a (DGEBA) epoxy resin using Bisphenol-A and Epichlorohydrin.
18. Preparation of diglycidyl aniline epoxy resin.
19. Preparation of polyester resin using Ethyleneglycol and maleic acid by polycondensation method.
20. Preparation of resol.

Reference (List B)

1. Experiments in polymer science-E.A.Collis, J.Bares and F.W.Billmeyer.
2. Principles of polymer systems-F.Rodriguez
3. Advanced practical polymer chemistry- Dr. Kuruvilla Joseph, Dr. G. D. Gem Mathew-polymer publication , 2001.
4. Experimental in polymer science -D.G. Hundiwale, V.D.Athawale, U. R. Kapadi, V.V.Gite., Newage International(P) Limited, Pubilishers 2009.

PHYSICAL CHEMISTRY OF POLYMERS

Sub.Code: MS14
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the thermodynamic behaviors of polymers
- To study the solubility and solubility parameters, nature of crystallinity, effects of radiation on polymers and cross-linking of polymers.

Course Outcome

The student will be able to:

- Realize the structure and properties of polymer molecules and micro molecular compounds.
- Understand the thermodynamic properties of polymers in low concentration solution compared to conventional chemical moieties.
- Differentiate between polymers and conventional micro molecular structure, size, molecular weight and thermodynamic behaviors.

Course Content

(Total session: 64 hours)

UNIT-I: Thermodynamics of polymers solutions: introduction to thermodynamics, Thermodynamics solubility of the systems,Vant hoff's equation. Change in Volume on dissolution of polymers. Thermodynamics of dissolution of polymers and their structures. Partial molar quantities, methods of calculation. Ideal and non-ideal solutions. Thermodynamic criteria of polymer solubility, solubility parameter. 16h

UNIT-II: Flory - Huggins theory. Entropy of mixing, enthalpy of mixing, Change in Gibbs free energy of dissolution of polymers. Dilute solution theory based on excluded molar volume. Thermodynamic properties. Perturbation theory and closed expressions. Second virial co- efficients, real polymer chains, Third Virial coefficients, lattices theories. 16h

UNIT-III: Phase equalibria: thermodynamic derivation of phase rule. Theory of binary system. Solid liquid equilibria. Thermal analysis. Crystalizability of polymers, melting temperature of polymers. Three component systems. Brownian plots. Systems involving two solids and a liquid. Partially miscible three liquid systems. Theory of polymer fractionation. The nature of the crystallinity state in polymers. 16h

UNIT-IV: Radiation chemistry of polymers, effect of radiation on polymers, structure and Properties, theory of polymer swelling, swelling of non-ionic network system. Swelling of ionic network system, IPN's: networks, sequential, simultaneous, full and semi IPN's, thermoplastic IPN's. 16h

Reference

1. Principles of polymer chemistry – P.J. Flory.-Encyclopedias- 672 pages.1995
2. Macromolecules in solution – H.merawetz. interscience. N.Y.1965
3. Principles of polymerization – G. Odian.-John Wiley & sons, Inc 2004.
4. Polymer colloids, A comprehensive Introduction: Rober M. Fitch –Springer 1971 (Academic Press)
5. Physical Chemistry of Polymers – A. Tager

INORGANIC AND NATURAL POLYMERS

Sub.Code: MS15
Paper: SCT
Duration of the paper: 03h
Exam Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the Mineralogical type and inorganic polymers structure, properties and applications.
- To study the Natural polymers like cellulose and natural cellulose/fibers, edible oils, gums, etc.
- To study the proteins, nucleic acids, polysaccharides, macromolecular structures, biological functions, biological information, enzymatic activity, bio-polymers-living macromolecules.

Course Outcome

The student will be able to:

- Realize the importance of inorganic and natural polymers and bio-polymers properties and applications.
- Understand the isolation, characterization of natural and bio-polymers.

Course Content

(Total session: 64 hours)

UNIT-I: Introduction. Mineralogical type inorganic polymers. Covalent inorganic polymers. Polymeric sulfur, Silicone polymers, Phosphonate polymers. Polyphosphozenes: History, critical account of preparation, properties, structure and applications, co-ordination polymers (phthalocyanines). 16h

UNIT-II: General survey of inorganic polymers, comparision of organic polymers with inorganic polymers, inorganic chains, rings and cages, fluorocarbons, carbides, borazenes, isopoly and heteropoly acids and their salts, silicates, zeolites. 16h

UNIT-III: Natural polymers: Classification, bio-polymers - introduction – functions –Cellulose, cotton, wool, silk, paper, rubber, collagen, hyaluroran- melanin, lignin – applications. Polymer from renewable resource: Introduction – Monomers and polymers from renewable resource materials: castor oil, natural gums, oleo chemicals, cashew nut shell liquid, carbohydrate derived monomers, furfural as a raw material for monomers and polymers. 16h

UNIT-IV: Structure of bio-polymers: Proteins, nucleic acids and polysaccharides – the Macromolecular structure and biological functions of polymers- primary, secondary, tertiary and quaternary structures –Biological information - structure and enzymatic activity – structural function of bio-polymers–living macromolecules. 16h

Reference

1. Inorganic Polymers – by J.E.Mark, H.R.Alcock and R.West, Prentice Hall Publishers.2005
2. Contemporary Polymer Chemistry- By J.E.Mark, H.R.Alcock and F.W.Lampe, Prentice Hall Publishers, 3rd Edition; 2005.
3. Introduction to Polymer Chemistry-by Charles E.Carroher Jr., CRC Press, Taylor & Francis, Boca Raton, 2010.
4. Principles of Bio-Chemistry – by L Lehninger, David L. Nelson, Michael M. Cox 1970
5. Introduction to Biological Chemistry – by Awapara.- Prentice Hall,1968.
6 Contemporary Polymer Chemistry – by H.R.Allcock and F.W.Lampe, Prentice-Hall Inc.2003
7. Organic Polymer Chemistry – by K.J.Saunders, 2nd Edition, Chapman & Hall.1973
8. Polymeric Materials from Renewable Resources – RAPR Technology Ltd., 4 (7) 1991.J.M.Methven, Pergamon Press, New York (1991).

9. Polymer Applications of Renewable Resource Materials – by E.D. Carrahar and L.H. Sperling, Plenum Press, New York (1981).
10. Principles of Polymer Science-P. Bahadur, N V Sastry- Narosa Publishing House.2002

NANO-SCIENCE

Sub.Code: MS16
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- Strengthen the intersections of scientific disciplines by supporting interdisciplinary research to facilitate convergence of knowledge, tools, and domains of nanotechnology with other areas in science and technology.

Course Outcome

The student will be able to:

- Realize the introduction to nanotechnology, definition, types, classifications, surface modification and their applications.
- Understand the different techniques of preparation of nano composites.
- Understand the electrical, optical, mechanical, thermal, morphological, micro- structural properties of nano composites.

Course Contents

(Total session: 64 hours)

UNIT-I: Introduction: Introduction to nanotechnology, definition, types, classification, surface modification of nanoclay with different organic compounds and their properties. Nanomaterials synthesis, chemical approaches, molecular switches nanowires, Synthesis, properties, characterization and applications nanoparticle, nanoplatelet, nanofiber reinforced Composites. 16h

UNIT-II: Techniques used for the characterization of noncomposites; Preparative methods and morphological study, Intercalation of polymer or pre-polymer from solution, in-situ intercalative polymerization method, Melt intercalation, properties of polymer- clay nano composites. 16h

UNIT-III: Nanocomposite properties- Mechanical properties, dynamic mechanical analysis, tensile properties, flexural properties, heat distortion temperature, thermal stability, fire retardant properties, gas barrier properties, conductivity, optical transparency, biodegradability of biodegradable polymers-based nanocomposites. Crystallization behavior and morphology of Nanocomposites, Rheology, melt rheology and structure–property relationship. 16h

UNIT-IV: Carbon nanotubes (CNTs)- Chemistry, types, structure, properties and applications. Comparison of CNT properties with graphite fibers, preparation of CNTs, purification, Surface modification of CNTs, properties- Mechanical, thermal, morphological, electrical properties. Methods of fabrication of CNT-polymer composites, properties of CNTs composites, characterizations of Nanocomposites by X-ray, electrical, thermal, optical, Raman spectra and TEM. Application of CNT-polymer composites. 16h

Reference

1. Polymer layered silicate and silica nano composites- Y.C. Ke, P. Stroeve and F.S. Wang, Elsevier, 2005.
2. Formation and properties of clay-polymer complexes. B. K. G. Theng- Elsevier, Amsterdam, 1979.

3. Chemistry of clay-organic reactions- B.K.G. Theng. Wiley, New York, 1974.
4. Vapour grown carbon nanofibres-polypropylene composites and their properties in Carbon nanotubes edited by V.N. Popov and P.Lambin, p.227- V.Chirala, G.Marginean, W.Brandl and T.Iclanzan, Springer (2006), Netherlands.
5. Recent Advances in Polymer Nanocomposites; Editors: S. Thomas, G.E. Zaikov and S.V. Valsaraj, CRC Ptress, 2009
6. Progress in Polymers Nanocomposites Research Editors: Sabu Thomas, Gennady E. Zaikov Novapublishers, 2009
7. Nanotechnology Fundamentals and Application-Manasi Karkare- I. K. International.2008

CHEMISTRY OF HIGH POLYMERS

Sub.Code: MS17
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the structure of polymers, Molecular weight and their types, polymer dispersity, degree of polymerization, chain length and polymerization techniques.
- To study the synthesis of polymer- support reagents or polymer-bound reagents it includes/avails both chemical reagent and polymer reagents that means micro to macro structures and properties.
- To control Molecular weight (tailor made requirements)
- Poly peptide synthesis and isolation by conventional chemical method is limitation, this can be overcome by polymer-support /polymer-bound reagents method.

Course Outcome

The students will be able to:

- Realize the concept of difference between chemical moieties(low molecular weight compounds) and polymer compounds.
- Understand low molecular weight compounds have specific /sharp molecular weight and their properties and applications are also narrow and specific.
- Understand about different molecular weights, their properties and applications.
- Realize the function of inhibitors, activators and chain extenders in controlling molecular weights.

Course Content

(Total session: 64 hours)

UNIT-I: Basic Principles of molecular weight : Importance of molecular weight control. Arithmetic mean-molecular weight average Mw, Mn, and Mv. Molecular weight distribution and its importance from the point of applications, Polydispersity index, determination of molecular weight- Theory, procedure and problems. 16h

UNIT-II: Polymerization techniques: Design criteria, polymer reactors, gas phase polymerization, comparison of the above. Batch and continuous processes, kinetics of cross-linking reactions in thermosets and influence of additives. Kinetics of Polymerization, addition, condensation, redox polymerization and continuous fiber reinforced thermoplastics (CFR) polymerization. 16h

UNIT-III: Introduction: Polymer-Support materials, styrene based polymers, functionalizations of styrene based polymers via chloromethylation and other methods, determination of functionalizations

in polymer supports. Polymer bound reagents. Introduction: polymeric oxidizing reagents, oxidation-reduction reagents, polymeric reducing agents, polymeric group transfer reagents, polymeric coupling agents, miscellaneous reagents, retardation inhibition, chain transfer branching effect, control of molecular weight, kinetic chain length, regulation and control, Molecular weight distribution (MWD), Carothers equation. 16h

UNIT-IV: Polypeptide synthesis on polymer support: Introduction, principles of Merrifield's Solid - Phase peptide synthesis, supports for solid phase peptide synthesis, linkage of first amino acid, protecting groups coupling of successive amino acids, cleavage of the resin- Peptide bond, purification, Peptides synthesis using polymeric active esters, basics of oligonucleotide synthesis, oligosaccharide synthesis, sequencing of peptides and proteins. 16h

Reference

1. Textbook of polymer science – F.W. Bilmeyer.-Wiley- India edition 1957.
2. Polymer science – V.R. Gowarikar, N V viswanathan, Jayaadev sreedhar-New age international Publishers.1986
3. Plastic materials and processing – brydson.-Elsevier 1965
4. Manufacture of plastics –Vol. I and Vol. II W. Mayo and Smith, van Nostrand reinhold 1964
5. Chemical process industries – Shreve R. Norris, Mc Graw- Hill education 1945.
6. Rubber technology and manufacture – C.M. Blow.-Institution of Rubber Industry.1971
7. Organic Chemistry and Synthetic Polymers by Lenz-Journal of chemical Education 1968.
8. Polymers as Aides in Organic Chemistry. N.K.Mathur, C.K.Narang, R.E.Williams, Academic Press, NY, 1980.-Elsevier

SEMESTER – II

PLASTICS TESTING

Sub.Code: MS21
Paper: HCT
Duration of the paper: 03h
Exam Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the Basic concept of testing.
- To study the material identification and its properties
- To Study thermal properties, viscosity, density etc.
- To study the mechanical, electrical, optical, chemical and permanence properties.

Course Outcome

The student will be able to:

- Identify plastic material.
- Familiar with characterization techniques.
- Understand the concepts of mechanical, electrical, optical, chemical and permanence testing equipments.

Course Contents (List A)

(Total session: 32 hours)

Unit I: Basics of Testing- Specification, Standards, test specimen & preparation of specimen, Pre-conditioning and test atmosphere - Familiarity with measuring instruments - Vernier Caliper, Micrometer, Thickness Gauge, Pie Tape, Go No Go Gauges etc. - Identification of plastics by Simple

Tests, Visual examination, Density, Melting point, Solubility test, Flame test and burning characteristics and chemical analysis test.- Specific gravity-Density by density gradient column, Bulk Density - Particle size by Sieve Analysis, Moisture analysis, Ash content, Filler and Fibre content, residual content 16 Hours

Unit II: Thermal Properties - Heat Distortion Temperature (HDT), Vicat Softening Temperature (VST), Long Term Heat Resistant Tests, Thermal Conductivity, Thermal Expansion, Brittleness Temperature -Melt Flow index, Viscosity, Dilute Solution Viscosity, K-Value, VCM content, Molecular weight calculation, Material Characterization, Apparent Density, Bulk Factor, Cup & Spiral flow rest, dynamic viscosity (Brookfield viscometer). 16 Hours

Reference (List A)

a. Plastics Testing Technology Hand Book – Vishu Shah
b. Simple Methods for Identification of Plastics – Brawn R. B.

Course Contents (List B)

(Total session: 32 hours)

UNIT-I Understanding of electrical properties of plastics like Dielectric strength, Dielectric constant and Dissipation factor, Insulation resistance, Volume and Surface resistivity, Arc resistance, Antistatic and ability to perform tests to determine the same. 08 Hours

UNIT-II Understanding of tests for determining Short-term Mechanical Properties - Tensile, Flexural, Compressive, Shear, Impact, Tear resistance, Hardness tests, Abrasion resistance, Friction properties along with long-term mechanical properties like creep and stress relaxation. 08 Hours

UNIT-III Understanding of optical properties of plastics such as Refractive index, luminous transmittance, Clarity and Haze, Photo-elastic properties, Colour measurements and Gloss, transparency and Opacity and ability to perform tests to determine the same. 08 Hours

UNIT-IV Knowledge of testing to determine Chemical & Permanence Properties of Plastics namely-Resistance to Chemicals, Immersion test, Stain Resistance of Plastics, Environmental Stress Cracking Resistance (ESCR), Water absorption, gas permeability-water vapor permeability 08 Hours

References (List B)

a. Plastics Testing Technology Hand Book – Vishu Shah
b. Simple Methods for Identification of Plastics – Brawn R. B.

PLASTICS PROCESSING TECHNIQUES

Sub.Code: MS22
Paper: HCT
Duration of the paper: 03h
Exam Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the melt process of thermoplastic
- To Study about injection moulding.
- To Study about compression moulding
- To study the Extrusion and blow moulding process
- To Study the compounding & calendaring process,
- To Study about secondary processes.

Course Outcome

The student will be able to:

- Understand injection moulding machine with different mould and material
- Understand Compression moulding technique with different mould and material
- Understand Extrusion and blow moulding process and its trouble shoot
- Understand secondary process like calendaring thermoforming roto molding calendaring etc.

Course Contents (List A)

(Total session: 32 hours)

UNIT-I Understanding of Basic Principles of Melt Processing of Thermoplastics, Effect of Polymer Properties on Processing- Injection Moulding Process - Basic Process Principles, Machine rating and Specifications - Types of Machines – Construction - Parts and its functions - Machine Start up and Shut down procedure - Operation procedure, Projected Area calculation, Shot Capacity, Clamping System, Type of Screws and their function- Process variables - Heating System - Ejection system – Back Pressure - Suck back - Drooling - Nozzle Types - Moulding cycle - Shot weight -Purging - Material recommendation – grades- Microprocessor controlled Injection Moulding- Interaction of process variables- machine operation- theoretical concepts and their relationship to processing- Shrinkage – Annealing - Dimensional Control - Moulding Records - Trouble Shooting 16 Hours

UNIT-II Knowledge of Compression Moulding & Transfer Moulding - Principle – Process – Machine Specification, Material recommendation and flow properties - Preheating Techniques, Process Variables - Flow Characteristics, Cycle Time, Heating and Cooling system, Faults and Trouble Shooting, Process Advantages and Limitations - Understanding of Rotational Moulding Process - Basic Process Principles, Machine Rating and Specifications - Types of Machines – Construction Parts and its functions, Process variables - Charge size - Wall Thickness Control - Heating and Cooling system, Faults – causes and remedies, Merits and Demerits of the process 16 Hours

Reference (List A)

1. Injection Moulding Theory & Practice – Rubin, Irvin.
2. Plastics Engineering Hand Book – Society of Plastic Industry Inc.
3. Plastics Processing Data Hand Book – D.V. Rosato.
4. Plastics Materials & Processing – Brent Strong.
5. Industrial Robot Handbook - Richard K. Miller, CMfg.E, Springer Science+Business Media, LLC
6. Total Quality Process Control for Injection Molding, 2nd Edition, M. Joseph Gordon, Jr.

Course Contents (List B)

(Total session: 32 hours)

UNIT-I Extrusion principles and construction, screw, compression ratio-back pressure, Types of extruder - Extruder heating & cooling systems - breaker plate - screen pack & its functions - screw & hopper cooling, Hopper, loading devices - Drying equipments – Process - Awareness of downstream equipments and extrusion plants for Pipe/ Corrugated Pipe/Tube, Wire & Cable covering, Blown Film-single layer, multilayer, laminates plant, Sheeting/Tape plant and Mono filament / Box Strapping plant. 08 Hours

UNIT-II Compunding machinery and devices - Principles - Operating characteristics - Machine construction – Specifications - Process control systems and working details of Batch mixers and continuous mixers - High speed mixer - Two roll mill and different types of mixers and kneaders - Single Screw extruder - Twin Screw extruder 08 Hours

UNIT-III Calendaring principles, Process variables, Types of Calendar Rolls - Heating & Cooling System - Roll Bending - Complete Description of Calendaring line with their function — Winding Types and Method - Finishing – Trouble Shooting and applications- Blow moulding - Advantages -

Material Selection, machines and their types, mold material, types of processes, die construction, process variables, programming, defects- causes and troubleshooting 08 Hours

UNIT-IV Understanding of Thermoforming principles – Advantages - Material Selection, machines and their types, mold material, types of thermoforming processes, process variables, defects- causes and troubleshooting- Secondary Processing Techniques - Powder Coating, Casting, Machining & Joining of plastics-Decoration of Plastics-Metalizing-Printing & Painting etc-Post moulding operations techniques, In-mould labeling - Dry mixers, banbury mixers, Ribbon blenders etc., 08 Hours

Reference (List B)

a. Compression Moulding – Iyesaw, A.I.
b. Technical Manual on Plastics Processing –
c. Plastics Engineering Hand Book – Society of Plastics Industry Inc.

PLASTIC TESTING AND PROCESSING PRACTICALS – I

Sub.Code: MS23
Paper: HCP
Duration of the paper: 03h
Exam Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives:

- To Study thermal properties, viscosity, density etc.
- To study the mechanical, electrical, optical, chemical and permanence properties.
- To test the above properties using different instruments.
- To study the melt process of thermoplastic
- To work on injection moulding, compression moulding, Extrusion, blow moulding & secondary process machines.

Course Outcome:

The student will be able to:

- Identify plastic material.
- Familiar with characterization techniques.
- Handle Testing equipment.
- Experiment with the concepts of mechanical, electrical, optical, chemical and permanence testing equipments.
- Handle injection moulding machine with different mould and material
- Handle Compression moulding technique with different mould and material
- Handle Extrusion and blow moulding process and its trouble shoot
- Handle secondary process like calendaring thermoforming roto molding calendaring etc.

List of experiments (List A)

(Total session: 64 hours)

1. Identification of Plastics by Simple methods Primary Tests – Elemental Analysis – Confirmation Tests
2. Determination of Density
3. Determination of Filler Content
4. Determination of Moisture Content
5. Determination of Volatile Content
6. Determination of Ash Content
7. Determination of VCM content
8. Determination of K-value for PVC resin

9. Determination of Melting Point
10. Determination of Melt Flow Index
11. Determination of Carbon Black Content and Dispersion
12. Determination of HDT & VSP
13. Specimen Preparation methods.

Reference (List A)

a. Plastics Testing Technology Hand Book – Vishu Shah
b. Simple Methods for Identification of Plastics – Brawn R. B.

List of experiments (List B)

(Total session: 64 hours)

1. Shop-floor Machinery, Lay-Out of Shop Floor, Safety aspects, Mold, Tool Handling and safety measures, use of PPE on the shop-floor.
2. Study of Hand Injection Moulding Machine in Idle-Run Observation (IRO), Parts & functions, Operating principle, free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition.
3. Study of Semi-Automatic Injection Moulding Machine in Idle-Run Observation (IRO), Parts & functions, Operating principle, free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Barrel etc.,
4. Automatic Injection Molding machines-Study of M/c Parts & function, Study of clamping systems on M/cs, Technical specification of Machine, Sequence on Machine, Definitions of all Processing Parameters & study of controls in M/cs.
5. Practice on operation of Compression & Transfer moulds with thermoset materials. Study of Process Principle, type of moulds & material used in thermoforming.
6. Rotomoulding - Machine-study in IRO, Process Principle & sequence of operation, Raw materials used, Mould-clamping practice on the M/c Operation practice to produce Rotomoulded components, Cycle-time analysis, Comparison of process with other processing processes.

Reference (List B)

a. Injection Moulding Theory & Practice – Rubin, Irvin.
b. Plastics Engineering Hand Book – Society of Plastic Industry Inc.
c. Plastics Processing Data Hand Book – D.V. Rosato.

STRUCTURE – PROPERTY RELATIONSHIPS IN POLYMERS

Sub.Code: MS24
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the basic concept of structure of the polymer molecules /compounds or materials
- To study the molecular structure, properties and applications are depending on structure.
- To study Polymeric materials are resistance towards many external agencies such as heat, fire, acid, alkali, sound, water, etc.
- To study Polymeric materials are smart materials or intelligent materials such as heat sensors, pressure sensors, light sensors, temperature, pH sensors, humidity, elctrical, magnetic, depending on structure.

Course Outcome

The student will be able to:

- Understand the concept of synthesis of homo polymers, co -polymers, ter-polymers, block co-polymers, etc,
- Realize the structural modification by synthesis of various polymerization techniques, co-polymerization, blending, grafting depending on customer specifications.
- Understand the importance of structural modifications like chemical and physical.

Course Content

(Total session: 64 hours)

UNIT-I: Polymer properties - Approach and the concept. Chemical structure of polymers – Introduction: Shapes and energy consideration, co-polymers, hetero-atomic polymers. Physical structure of polymers– introduction: Melt viscosity, inter-chain and intra-chain forces; Glass transition temperature; Crystallinity; Elastomers, fibers, plastics and their correlation with Tg and Tm (structural features). Physical properties of polymers in relation to chemical structure: Volumetric properties– Volume and density, thermal expansion. 16 h

UNIT-II: Calorimetric properties – Heat capacity, enthalpy and entropy; transition temperatures – Tg, Tm, and relationship between Tg and Tm of polymers; Solubility– The solubility parameter, solubility limits. The crystallinity of polymers,Molecular aggregation, molecular arrangement in crystallites, Polyethylene, syndiotactic vinyl polymers, Polytetrafluoroethylene (PTFE), polyvinyl alcohol (PVA), polyesters, polyamides, polydienes. The principles of crystallite structure, single crystals of polymers, determination, mechanism and kinetic treatment of crystalisation. Properties of polymers in fields of force. 16h

UNIT-III: Mechanical (visco-elastic) properties, effect of shape and structure on material properties like modulus of elasticity, tensile properties, fracture toughness, impact strength, crazing, ductile-brittle transition. Influence of molecular structure on electrical and optical properties. Influence of the process variables, orientation, measurement, quantitative relationships for some physical quantities after orientation, generalized stress-strain relationship for polymers. 16h

UNIT-IV: Diffusion of gasses and vapors in polymers, influence of molecular structure to predict the properties of specialty polymers- Water soluble polymers, oil soluble polymers, oil insoluble polymers, flame retardant polymers, flexible polymers, water repellant polymers, heat resistant polymers, transparent polymers. 16h

Reference

1. Properties of polymers : correlation's with chemical structure by Van Krevelen, - Elsevier. 4th Edition1972
2. Polymers: structure and bulk properties – Patrick Mearos. Journal of chemical education, 1966
3. Structure properties relationships in polymers – Raymond B. Soymour and Charles E. Carraher, Plenum Press Newyork.1984
4. Plastics: how structure determines properties – Gruenwald 1993. Hanser publishers
5. Injection moulding theory and practice – I Rubin 1973.
6. Handbook of engineering Polymeric materials by Nicholas P. Chermisinoff.1997
7. Injection moulding hand book by Rosato.-Springer 1985.
8. Properties and behaviour of polymer science-vol 2-A John Wiley & sons, INC., Publication.2011
9. Property of polymers- D W Van Krevelen, K.te Nijenhuis Elsevier.1972
10. Edward Miller, "Plastics Products Design Hand Book", Marcel Dekker,
11. Laszlo Sors and ImreBalazs, "Design of Plastics Moulds and Dies", Elsevier, Amsterdam Oxford - Tokyo - NY, 1989.

12. P.S.CRACKNELL and R.W DYSON, "Hand Book of Thermoplastics - Injection Mould Design", Chapman & Hall, 1993.
13. S.Levy&J.H.Dubois, "Plastic Product Design Engineering Hand Book", Van Nostrand Reinhold Co., New York, 1977.

POLYMER PHYSICS

Sub.Code: MS25
Paper: SCT
Duration of the paper: 03h
Max Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the micro-structural properties, thermodynamic and flow properties of polymers.
- To study the basic concept of rheology properties like viscosity, density, molecular weight and mechanical properties of polymeric materials.

Course Outcome

The student will be able to:

- Understand the concept of rheological properties of polymeric materials such as viscosity, density, determination of molecular weight, refractive index.
- Realize the nucleation and growth of crystals and their properties.
- Understand the concepts of physical properties of polymeric materials.

Course Contents

(Total session: 64 hours)

UNIT-I: Structural morphology, dilute solution properties, thermodynamics, kinetics of chain and step polymers, concentrated polymer solutions and polymer melts, amorphous and crystalline state, glass transition. 16h

UNIT-II: Nucleation and growth of crystals, cross-linked polymers and theory of rubber elasticity, mechanical behavior of polymers. 16h

UNIT-III: Basic concepts of rheology: Dependence of shear viscosity on temperature, pressure, molecular weight, flow curve, theory of linear visco-elasticity. Newtonian, Non-Newtonian and visco-elastic fluids. 16h

UNIT-IV: Continuum Theories and related models, non-Newtonian liquid flow through cylindrical pipes, couette flow, rheology of calendering and extrusion, viscometry, cone and plate viscometers. 16 h

Reference

1. Future Mechanics of Polymers- J.G Williams, Horwood, Chisester, 1984. Ellis Horwood ltd.
2. The Chemistry & Physics of Polymers- V.N. Kuleznev & V.A Shershnev, Mir Pub, Moscow,1990.
3. Introduction to Polymer Physics- I.L Perpechko, Mir Pub, Moscow, 1981.
4. Physical Chemistry of Polymers- A. Tager, Mir Pub, Moscow, 1978.
5. Introduction to Physical Polymer Science- L.H Sperling, John & Wiley, 2001
6. Viscoelastic Properties of Polymers, 3rd Ed.- J.D Ferry, Wiley, New York, 1980
7. Polymer Melt Rheology- F.N. Cogswell, Woodhead Publishing, 1983.
8. Rheology- Christopher W. Malosko, John & Wiley, 1980.

SURFACE COATING AND ADHESION TECHNOLOGY

Sub.Code: MS26
Paper: SCT
Duration of the paper: 03h
Max Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the different types & functions of coating.
- To study the Characterization of Coatings
- To study the importance of coating for protection from corrosion and degradation or deterioration of substrates.

Course Outcome

The student will be able to:

- Realize the basic concept of industrial coating resin synthesis, formulations and applications as coatings.
- Understand the manufacturing and properties of organic and inorganic pigments and their dispersions.
- Understand the surface preparation and coating applications.
- Test and Evaluation of coatings.

Course Contents

(Total session: 64 hours)

UNIT-I: Industrial coating resins- Synthesis, properties, formulations and applications as coatings of the following resins to be discussed. Alkyds and polyesters, phenol formaldehyde, silicon resin, epoxy resin, chlorinated rubber, polyurethanes and acrylic resins. 16h

UNIT-II: Pigments & their dispersion - Manufacturing and properties of organic and Inorganic pigments. Factors affecting dispersions, preparation of pigment dispersion, grinding equipment. 16h

UNIT-III: Coating processes – Surface preparation: Mechanical cleaning, solvent cleaning, alkali cleaning and acid pickling. Chemical conversion treatment- Coating application: Mechanism of film formation - Applying processes: Brushing, dip coating and flow coating, curtain coating, roller coating and spray coating – Fixation - Curing: Physical, chemical and oxidative - Factors affecting coating properties. 16h

UNIT-IV: Testing and evaluation of coatings – Physico-mechanical, optical, and environmental. Application of paints- Appliance finishes, automotive finishes, coil coating, can coating, marine coating, Curtain coatings and aircraft coating. 16h

Reference

1. Organic coatings- Science and Technology - Swaraj Paul, WILEY 1985.
2. Handbook of Plastics- Elastomers and Composites - Charles A Happer, Mc Graw- Hill, 1968.
3. Formulation of organic coatings- Norman I. Geynes, Glenn N. Danziger, Frederick C. Kinsler-Van Nonstrand Co.1967
4. The technology of paints- Varnishes and lacquers-Ed., by Morgan & Martens, Reinhold,1968
5. Hand book of Adhesive technology, Pizzi, A. (ed); Mittal, K.L. (ed), Marcel Dekker, New York,1996.
6. Adhesion and adhesives technology: an introduction, A.V. Pocius, Hanser/Gardner, Munich, 1997.
7. Adhesion and Adhesives - Science and Technology, Kinloch, A.J., Chapman and Hall, 1987.

POLYMER MEMBRANES AND DRUG DELIVERY

Sub.Code: MS27
Paper: SCT
Duration of the paper: 03h
Max Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives:

- To study the different types of polymer membranes.
- To study the characterization of membranes
- To study the role of Polymers in controlled release of drug delivery

Course Outcome:

The student will be able to:

- Understand the concept of membranes preparation.
- Realize the different techniques such as controlled drug delivery, muco adhesive polymers,
- Understand the various applications of membranes.

Course Contents

(Total session: 64 hours)

UNIT-I: Fundamentals of Membranes - Introduction to membranes, definition, classification of membranes,. Homogenous dense membranes, Heterogeneous asymmetric membranes, Thin film composite membranes, Liquid membranes-ion exchange membranes, Polymer selection for development of membranes, Polymer selection for development of membranes polymer property, Strength, Viscosity, Chemical resistance, Processing temperature, Factors membrane performance 16 h

UNIT-II: Development and characterization of membranes- Development of polymer membranes, Modification, Blending, Cross linking,. Grafting- Copolymerization,Characterization of membranes, Solution techniques; Viscosity, Density, Ultrasonic velocity, Thermal methods; TGA, DSC, TMA, Spectroscopy methods; UV, FT-IR, NMR, Optical methods; SEM, TEM and XRD. Application of Membranes, Various applications and uses of membranes; Micro filtration, Ultra filtration, Reverse osmosis-Gas permeation, Pervaporation, Nano filtration, Dialysis, Electro dialysis. 16 h

UNIT-III: Self-assemblies as promising Vehicles For Drug Delivery, Introduction, Various self assembled aggregates as carriers, Surfactants micelles, Liposomes, polymeric aggregates, Polymeric micelles, Polyion, functional properties of polymeric carriers, Morphological criteria,solubility and stability- Biocompatibility, drug loading and releasing characteristics, Biological aspects, Pharmacokinetics at the systemic level, Cellular uptake , Release of drugs in the cell. 16 h

UNIT-IV: Role of Polymers in controlled release of drug delivery - Introduction, Currently available polymers; Diffusion- Controlled systems- Solvent- Activated systems– Chemically controlled systems, Magnetically controlled systems, Soluble polymers as drug carriers: Pinocytosis, Ideal soluble polymers, Biodegradable or bioerodible polymers: Drug release by matrix solubilization, Erodible diffusional systems, Monolithic systems , Mucoadhesive polymers, Polymer containing pendent bioactive substituents,Matrix systems. 16 h

References

1. Pervaporation membrane separation processes–RYM.Huang, Elsevier Publications.1991
2. Introduction to Molecular Science, Second Edition – Petrmunk and Tejraj M. Aminabhavi. Wiley Online international,1989
3. Drug delivery systems (second edition)–Vasant V.Ranade, A.Mannfred Hollinger.CRC Press, 2003

SEMESTER III

ADVANCED POLYMERIC MATERIALS

Sub.Code:MS31
Paper: HCT
Duration of the paper: 03h
Max Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the specialty plastic and its application.
- To study the applications of biodegradable plastic and nanotechnology

Course Outcome

The student will be able to:

- Understand the Specialty plastic and its application.
- Understand the biodegradable plastic and its importance, its usage in different environment

Course Contents

(Total session: 64 hours)

UNIT-I Knowledge of Specialty Plastics- Liquid crystal polymer (LCP), Polyimides (PI), Polyether ether ketone (PEEK) etc. Sources of Raw Materials, Manufacturing - General Characteristics, Structure & Properties-Processing Behavior 16 Hours

UNIT-II Knowledge of biodegradable plastic Bio Plastic for Principle and Mechanism of Plastics degradation Natural Bio-degradable Polymers – Synthetic, Bio-degradable Polymers - Water soluble Polymers Bio plastics types, properties, Test methods for the same 16 Hours

UNIT-III Overview on Nano technology, Nano materials, active & passive nano structure, nano composites) 16 Hours

UNIT-IV Application of advanced plastics in Automobile, Agriculture, Medical, Aerospace, Aeronautical, Defence etc. 16 Hours

References

a. Plastics Materials – J.A. Brydson.
b. Plastic Materials Hand Book – A.S. Athalye.

POLYMER CHARACTERIZATION

Sub.Code: MS32
Paper: HCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the instrumentation theory, principle and applications of DSC and TGA for thermal analysis and thermal stability of Polymers.
- To study the chromatographic techniques like GC, GPC, and HPLC for analysis of the purity of monomers, polymers, additives, Mechanism of separation, Molecular weight distribution (MWD), purity and composition.
- To study the morphology of polymers by SEM, Microstructural prpoerties by X-ray diffraction analysis; WAXS, SAXS, etc.

Course Outcome

The student will be able to:

- Understand the theory, principle and instrumentation technique of DSC and TGA.
- Understand the theoretical and instrumentation technique on various types chromatography.
- Use the Theoretical method of various types of molecular weight determination of polymers.
- Cognise the theory and experimental method to determine molecular weight of polymers (by viscosity method).

Course Content

(Total session: 64 hours)

UNIT-I. DSC: Instrumentation, theory, practice and applications of thermal analysis :DSC:Physical transitions, melting thermograms, heat of fusion and degree of crystalanity or isotacticity. Random copolymer structure. Block co-polymer structure. Polymer mixture melting point depression by diluents, crystallization, melts crystalisation, cold crystalisation. Glass transition- Crystal-crystal transition. Chemical reactions-Curing, polymerisation. Kinetics of Curing (Broido's Method, Kissinger's Method), plasticizer effect. 16h

UNIT-II. TGA: Determination of degradation kinetic parameters. Method of Freeman and Carrol methods involving maximization rates. Method of multiple heating rates.Method of variable heating rate for a single thermogram. Estimation of thermal stability from TGA curves. Quantitative methods-Semi-quatitative and qualitative methods, thermal degradation behavior of some polymers by TG methods. Kinetics of thermal degradation, OIT, purity, fiber content, composition of compounded polymers. 16h

UNIT-III. Chromatography – GC, GPC and HPLC – Analysis of the purity of monomers, additives, principle's of GPC, mechanism of separation, theory and technique, instrumentation. Molecular weight distribution (MWD), purity and composition. 16h

UNIT-IV. Polymer Morphology: Optical microscopy, TEM. SEM, AFM, X-ray diffraction analysis: Wide angle X-ray scattering (WAXS) and small angle X-ray scattering (SAXS), analysis of molecular structure of simple polymers, chain conformation, chain packing, disorder in crystals, degree of crystalinity, micro- structural parameters, degree of orientation. Basic principles of TMA and DMA. 16h

Reference

1. Thermal characterization of polymeric materials – E.A. Turi.-Jornal of Polymer Science.1981
2. Analysis of polymers – an introduction- T.R.Crompton.-Springer.1971
3. Instrumental methods of analysis – Willard, dean and merit.- Journal of chemical Education 1975.
4. Polymer characterization – D. Cambell and J.R. White.2nd edition CRC Press, 2000
5. Experimental methods in polymer chemistry – J.F. Rabek.-Wiley Online Library.1980
6. NMR Frank A.Bcovey, 2nd edition Academic Press 1988.
7. Nano Technology-Fundamentals and Applications-Manasi Karakare- I. K. International.2010

PLASTICS TESTING AND PROCESSING PRACTICALS – II

Sub.Code: MS33
Paper: HCP
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the mechanical, electrical, optical, chemical and permanence properties.
- To test the above properties using different instruments.
- To study the Extrusion and blow moulding process
- To Study the compounding & calendaring process,
- To Study about secondary processes

Course Outcome

The student will be able to:

- Handle testing equipments for mechanical, electrical, optical, chemical and permanence testing of polymers.
- Handle Extrusion and blow moulding process and its trouble shoot
- Understand secondary process like calendaring thermoforming roto molding calendaring etc.

List of experiments (List A)

(Total session: 64 hours)

1. Determination of Tensile, Flexural & Compressive Properties
2. Determination of Izod & Charpy Impact Test
3. Determination of Burst Strength, Dart Impact Resistance for Plastics Films
4. Determination of Hardness (Shore -A & D, Rockwell Hardness, Barcol Hardness)
5. Determination of Abrasion Resistance
6. Study of Compounding, Blending using Two Roll Mill
7. Determination of Dielectric Strength & Dielectric constant
8. Determination of Volume and surface resistivity
9. To conduct Glow Wire Test
10. Determination of Arc Resistance and CTI
11. Determination of Gloss & Opacity
12. Determination of Luminous Transmittance, Haze & Clarity,
13. Determination of Tg and Tm by DSC

References (List A)

a. Plastics Testing Technology Hand Book – Vishu Shah
b. Simple Methods for Identification of Plastics – Brawn R. B.

List of experiments (List B)

(Total session: 64 hours)

1. Extrusion-Process. Operation & Practice.
2. Compunding machinery - Operation & Practice.
3. Calendaring. - Operation & Practice
4. Blow moulding - Operation & Practice
5. Thermoforming machine- Operation & Practice
6. Ancillary Equipment -Hopper Dryer, Chiller, Mould Temperature Controller, Cooling Tower, Mixer, dehumidifier, pulveriser, Grinder, Air-compressor

References (List B)

a. Compression Moulding – Iyesaw, A.I.
b. Technical Manual on Plastics Processing – Charles A. Harper
c. Plastics Engineering Hand Book – Society of Plastics Industry Inc.

ENVIRONMENTAL SCIENCE AND PLASTICS WASTE MANAGEMENT

Sub.Code:MS34
Paper: SCT / OET
Duration of the paper: 03h
Max Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the scope and importance of environmental science
- To study how to reduce the pollution in environment
- To understand plastic waste management methods & guidelines.

Course Outcome

The student will be able to:

- Understand methods of plastic recycling.
- Proper usage of plastic.
- Convert plastic waste to useful products.

Course Contents

(Total session: 64 hours)

UNIT-I Scope and importance of environmental science, effect human of activities on environment - Concept of eco system, structure and function - Awareness about water resources, food resources, mineral resources land resources and energy resources 16 Hours

UNIT-II Awareness about environmental pollution such as air, water, land, thermal, and water conservation, global warming, ozone layer depletion- Environmental protection acts and disaster management system types and policy 16 Hours

UNIT-III Understanding of Plastics Waste - sources, collection, segregation, identification by simple methods and techniques employed for its separation - Plastics Waste Management Techniques – recycling and its types, and use of plastics waste for energy recovery, road construction- Machinery and Value addition Process 16 Hours

UNIT-IV Basic Mechanical recycling Plant, Additives for improving quality of recycled products- Guidelines and Legislation in India for Plastics waste and its recycling 16 Hours

Reference

a. Introduction to environmental engineering and science, 2nd edition, prentice hall 2003–Gilbert M Masters
b. Environmental Science and engineering –Benny Joseph, Tata McGraw-Hill, New Delhi 2006
c. Environmental Science, CengageLearning India 2014 –G.Tyler Miller and Scott.
d. Environmental studies from crisis to cure, Oxford University third edition
e. A text book of environment studies –Shashi Chawla
f. Technical Manual on Plastics Processing – CIPET
g. Recycling & Plastics Waste Management –Dr. J S Anand
h. Environmental Engineering & Management –Suresh K. Dameja

POLYMER BLENDS AND COMPOSITES

Sub.Code: MS35
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the scope and importance of polymer blends.
- To study about Polymer composite
- To study processing methods of blends.

Course Outcome

The student will be able to:

- Synthesize and fabricate new polymer blends and composites and achieve the best performance products.
- Understand the different tests for mechanical properties like tensile strength, flexural, young's modulus, impact strength etc.

Course Contents

(Total session: 64 hours)

UNIT-I: Polymer Blends: Definition, difference between polymer blends and alloys, classification of polymer blends and alloys, principle of polymer compatibility, miscibility effect of molecular structure on polymer-polymer interaction, thermodynamics of polymer-polymer mixing, Blend morphology & characterization. Techniques for determination of polymer- polymer miscibility, preparation and manufacture of polymer blends, characterization of blends and applications. 16h

UNIT-II: Polymer composite systems: Definition, reason for composites, chemistry, properties & applications. Types of composites, reinforced thermoplastic, thermoset, elastomers - Resins (polyesters, epoxide, vinyl ester, phenol formaldehyde, polyimide, semi crystalline and amorphous polymers) additives, reinforcements (particulate, fibrous, gaseous). Factors affecting the performance of composites. 16h

UNIT-III: Processing techniques: Open mould, hand layup and spray layup, vacuum bag moulding, pressure bag moulding, autoclave moulding, closed mould, Sheet molding compound (SMC), Dough moulding compound (DMC), Resin transfer molding (RTM). Continuous manufacturing process- Pultrusion, filament winding, centrifugal casting - Applications. 16h

UNIT-IV: Mechanical behavior of composites: Analysis of continuous fiber composites and Short fiber composites. Deformation behavior of single ply and laminates. Creep, fatigue impact. Electrical and thermal properties. 16h

Reference

1. Paul D.A., and Newman S., "Polymer Blends", Academic press. Elsevier 1978.
2. Dyson, R.W., "Engineering Polymers", Blackie, 1990. Champam & Hall, NY.
3. Crawford, R.J., Plastics Engineering 2nd edition, Pergamon Press.1987.
4. Richardson, T., Composites– a design guide industrial press Inc., New York, 1987.
5. Polymer engineering composites. Ed.M.O.W.Richardson, Applied science publishers, London.1977
6. Hand book of composites- G.lubin,Van Nostrand,New York,1982.

7. Mohar J.G et al SPI Hand book of technology and engineering of Reinforced plastic composites, Van Nostrand,New York. Polymer blends, Paul D.R and Newman S. Academic.2nd edition 1973
8. Polymer Blends and Alloys- R.P. Singh, C.K. Das, S. K. Mustafi- Asian Book Private Limited.2002
9. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., New Delhi, 2003
10. A. Ya. Malkin, A.A. AskaDsky, V.V. Koverica Experimental methods of polymers, Mir Publishers, Moscow, 1998.
11. B. Sivasankar, Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2012
12. Iver, Mead and Riley, Hand book of Plastic test methods, Illith Publishers, New York, 1982.
13. Vishu Shah, Hand book of Plastics Testing and Failure Analysis, 3rd Edition, John-Willey & Sons, New York, 2007.

ADHESIVE MATERIALS

Sub.Code: MS36
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the definition and mechanisms of adhesion.
- To study about Characterization of adhesives.
- To study the Adhesive types & its applications.

Course Outcome

The student will be able to:

- Understand the concept of definition and mechanism of adhesion materials.
- Realize the synthesis of bio-adhesive materials like dextrose adhesives, starch based paper adhesion, envelops, bookbinding and cellophane adhesives.

Course Contents

(Total session: 64 hours)

UNIT-I: Adhesion mechanism definition and mechanisms of adhesion- Mechanical interlocking – Inter-diffusion theories, adsorption and surface reaction. Surface topography, wetting and setting, thermodynamic work of adhesion, Influence of constitution on adhesion,Inter-facial bonding, Coupling agents. 16 h

UNIT -II: Characterization of adhesives Principle of fracture mechanics, peel, lap sheen and butt tensile tests. Pull out of an extendable fibre, various testing of adhesives, energy dissipation, Plasticity, Strength of elastomers. Industrial adhesives inorganic adhesives, Animal glues, Caesin, Starch, Cellulosics. Principle of compounding, Role of resin, Fillers, Antioxidants, Accelerator systems. 16 h

UNIT-III: Adhesive types: Adhesive from natural, butyl, nitrile, styrene – Butadiene – Carboxylic polymers and Neoprene rubbers, polysulphide, phenolic resin, epoxy, polyurethane, polyvinyl acetate, polyvinyl alcohol, polyvinyl acetal, acrylic, high temperature silicone adhesives. Water based, Pressure sensitive, Hot melt adhesives, Anaerobic adhesives. 16 h

UNIT-IV: Applications of adhesives: Adhesives for building construction, medical use, automobile industry bonded and coated abrasives, Fabrics, cyanoacrylate based adhesives, bonding technology for textile, metal, plastics, wood, paper and glass. 16 h

Reference

1. Handbook of adhesive bonding -V.Cagle Charles- McGraw Hill Book Company, New York, 1978.
2. Treatise on adhesion and adhesives, Vol.5- R.L.Patrick- Marcel Dekker Inc., New York, 1981
3. Adhesives in engineering design- W.A.Lees, Springer Verlag, Berlin, 1984.
4. Industrial adhesion problems- D.M. Brewis and D.Briggs (Ed.), Wiley-Interscience Publication, New York, 1985.
5. Preparative method in polymer science- Wayne R. Sorenson, Tod W. Campbell.

RUBBER TECHNOLOGY

Sub.Code: MS37
Paper: SCT
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To promote and protect the interest, growth and development of the rubber industry.
- To foster Co-operation among individuals and units engaged in the manufacture of rubber goods with a view to advancing and safeguarding the interest of the industry.

Course Outcome

The student will be able to:

- Understand the fundamental concept of rubber and its properties and applications.
- Realize the specialty rubbers, high performance rubber.
- Become fully aware of the processing of rubbers

Course Contents

(Total session: 64 hours)

UNIT-I: Fundamentals of Rubber - Criteria for a polymer to behave as a rubber, Structure vs Tg, chemical, mechanical and electrical properties, Polymerization types and techniques involved in production of general purpose rubbers , Ozone attack on rubbers, Protection against oxidation, Antioxidants, Network bound antioxidants, Vulcanization, Effect of cross linking density on properties, Role of accelerators, Activators, Non–sulphur vulcanization systems. 16 h

UNIT-II: Specialty rubbers heat resistant rubbers, Polyisobutylene, butyl and EPDM rubbers, Solvent/oil resistant rubbers, Nitrile, neoprene and chloroprene rubbers, ethylene methyl acrylate (EMA), alkyl acrylate copolymer (ACM), Ethylene vinyl acetate (EVA) Hypalon and chlorinated polythene (PE), High performance, specialty and modified rubbers, Fluorine containing and silicone rubbers, polyurethanes, polyethers, polysulphide, polyalkenomers and thermoplastic elastomers, Reclaim, liquid and powdered rubbers, ebonites. 16 h

UNIT-III: Processing of rubber – Mixing operations – Composition, Concentration, stabilization, coagulation, open mill mixing, internal and continuous mixers, Forming operations ,Calendaring, Extrusion –Spreading and moulding operations- Manufacture of tyres and tubes rubber product, Functions, requirements, Basic design reinforcing systems, Construction, Manufacture, Testing, Tube manufacture. 16 h

UNIT-IV: Compounding for tyre and tube. Belting, hoses and footwear, belting and hoses, Conveyor, transmission (V and flat) belting , braided and hand–built hoses, Compounding, Footwear and ports goods, Hot air vulcanized, Compression moulded, Direct moulded process for shoe bottoming - Injection moulded sole and heel units, Safety and antistatic foot wear, Micro and macrocellular rubbers, expanding rubber by nitrogen gassing and chemical blowing agents. 16 h

Reference

1. Rubber Technology- M.Morton, Van Nostrand Reinhold, 1987.
2. Developments in Rubber Technology, Vol. 1 – 4, A. Whelan and K.S.Lee, Applied Science Publishers, London 1981.
3. Hand Book of Elastomers- A.K. Bhowmick and H.L.Stephens, Marcel Dekker, New York, 1988.
4. Rubbery Material and their Compound- J. A. Brydson, Kluwer Academic Publishers Group, 2001.
5. "Rubber Technology and Manufacture", 2rd -C. M. Blow and C.Hepburn- Edn., Butterworths, London, 1982.
6. Injection Moulding Machine- A. Whelan- Elsevier Publications, London, 1989.
7. 1. A.K. Bhowmick and H.L.Stephens, Hand Book of Elastomers, Marcel Dekker, New York, 1988.
8. B. Kothandaraman, Rubber Materials, Ane Books Pvt. Ltd., New Delhi, 2008.
9. C.M.Blow and C.Hepburn, "Rubber Technology and Manufacture", 2nd Edn., Butterworths, London, 1982.

PLASTICS PRODUCT AND MOULD DESIGN

Sub.Code: MS38
Paper: OET
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To study the engineering drawing and new product development
- To study the concept of 3D printing & types.
- To Study injection mould design.

Course Outcome

The student will be able to:

- Draw basic engineering drawings
- Understand 3D printing & its types.
- Familiar with injection mould drawing .

Course Contents

(Total session: 64 hours)

UNIT-I Engineering Drawing Concepts - Orthographic views, conversion of pictorial view into orthographic view, Dimensioning techniques, Sectional views and assembly drawing. Blue print reading Knowledge of Product Design - Plastics product design - Concepts - Essential factors – process variables vs product design - Uniform and symmetrical wall thickness - part geometries - draft angle Ribs - internal sharp corners and notches, Bosses - Holes -Threads - undercuts - Hinges metal inserts – Tolerances 16 h

UNIT-II. Recent trends in product development: Introduction to Prototype & Rapid prototype (RPT) - 3D Printing –Types & Design aspects- applications and benefits 16 h

UNIT-III Injection Mould Design - Selection of Injection moulding machines Shot capacity, Plasticizing capacity, Clamping force and Daylight, mould elements , Bolsters - mould alignment, Feed system, Ejection types, Mould cooling, Venting, parting line and parting surface Requirement of Core & Cavities for Single & Multi impression mould, Cavity & Core finishing, Gate Types, Runners, mould material, Bill of materials 16 h

UNIT-IV Advanced injection mould design - Blow Mould design- Compression Mould Design- Extrusion Die design 16 h

Reference

a. Plastics Product Design Beck, R
b. Injection Mould Design – Pye R.G.W
c. Injection Moulds 130 Proven Design Gashtrow
d. Engineering Graphics – N D Bhat
e. Engineering Graphics – K Venugopal

SEMESTER IV

INTERNSHIP / IN-PLANT TRAINING (INDUSTRY OR RESEARCH INSTITUTES)

Sub.Code: MS41
Paper: HCI
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To gains the corporate experience through corporate environment
- To learn new concepts and technologies adopted by various companies.
- To study the control of raw material in mass production.

Course Outcome

The student will be able to:

- Handle Shop Floor activity in mass production
- Handle trouble shooting
- Handle advanced machines being utilized
- Work under pressure within given time.

Course Contents

1. Students should undergo internship in the final semester under the supervision of a Manager/Plant Head/ Chief Engineer etc. in the industry or research institute
2. Students should be able to work in various machines used in industry or research institute.
3. Internal marks will be based on attendance sheet & Performance feedback from the internship.
4. Evaluation by internal & external examiner (Industry expert) of internship during external examination will be based on presentation about the company & understanding of work carried out during the course of internship.

DISSERTATION / PROJECT WORK (INDUSTRY OR RESEARCH INSTITUTES)

Sub.Code: MS42
Paper: HCD
Duration of the paper: 03h
Max. Marks: 70
Internal Assessment: 30
Total Marks: 100

Objectives

- To define a problem in plastic industry.
- To develop new formulations & optimization through various testing & characterizations.
- Development of new polymer products for various applications.
- To do quality assurance in polymer industry.

Course Outcome

The student will be able to:

- Handle advanced machines being utilized
- Carry out R&D activities
- Generate Scientific reports & publications in peer reviewed journals.

Course Contents

1. Undertake a project on Polymer science under the supervision of a faculty member and complete the same during the course of the final (even) semester. Project work shall be identified in collaboration with industry preferably.

2. Project Topic should cover any of the following: testing/increasing productivity/ quality assurance/ estimation and economics of production/ repair and maintenance of plant and equipment/ identification of raw material thereby reducing the wastage/ suggesting substitutes of the polymer being used/ Any other related problems of interest for host industry.

3. The thesis shall be submitted by the student before the commencement of the examination duly signed by the Internal & the Industry Guide along with attendance sheet & Performance feedback. The project report evaluation & viva-voce shall be conducted jointly by the Internal & the External (Industry/Subject expert) examiner at the end of the semester will be based on project presentation & project report.

OPEN ELECTIVE

Sub.Code: MS43
Paper: OET

Any recognized course Certificate (Online/Offline)

The students of M.Sc. Polymer Science have to do one Open Elective course . Students are allowed to take massive open online courses (MOOCs) on the SWAYAM platform in **non-polymer domain**, delivered by the NPTEL and other national coordinators (hereafter abbreviated to SWAYAM-NPTEL), for the Open Electives (OEs) of the M.Sc. Polymer Science as detailed below:

Credit Transfer:

- Self Learning Mode: In self learning mode, the final semester students shall be allowed to opt for SWAYAM-NPTEL MOOCs.
- Opted SWAYAM-NPTEL MOOCs for Open Electives (OEs) should have prior approval from the Head of Institute for proper transfer of credits, for the award of degree. All such lists of approved SWAYAM-NPTEL MOOCs for OEs and other courses along with the registered list of candidates shall be presented to the BoS, whenever conducted.
- The Head of Institute shall approve the list of SWAYAM-NPTEL courses of 8 week/12 week duration, which shall be considered equivalent to 04 credits courses based on exam Certificate issued.
- The HoD shall release the list of students who opted to do SWAYAM-NPTEL MOOCs for theory courses during the start of final semester. This students' list for each MOOC shall also indicate the identified faculty coordinator for that MOOC.
- The faculty coordinator for MOOC: The faculty coordinator shall join the MOOC as a course mentor and shall follow-up for (i) ensuring SWAYAM-NPTEL MOOC registration by students on time, in coordination with the SWAYAM Institute faculty coordinator; (ii) consistent efforts by students in watching all videos; submitting all assignments on time; and (iii) students registering for the NPTEL exam.