COURSE TITLE : FIBRES AND COMPOSITES
COURSE CODE : 4095
COURSE CATEGORY : A
PERIODS/WEEK : 5
PERIODS/SEMESTER : 90
CREDITS : 4

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Natural Fibres	24
II	Man Made Fibres	22
III	Composites and their Constituents	22
IV	Composites, Process and Moulds	22
	TOTAL	**90**

OBJECTIVES

MODULE - I

1.1.0 **Understand thecultivation,collection,properties, and application of natural fibres**
1.1.1 Define Fibres
1.1.2 Distinguish Fibre ,Fibre forming plastics and elastomers
1.1.3 Classify fibres
1.1.4 Describe the collection, properties, structure and application of cotton, linen, jute, coir and sisal
1.1.5 Explain the production, properties and application of Asbestos fibre
1.1.6 Explain the preparation, properties and application of various fibres like silk wool and other animal hairs.
1.1.7 Explain the production, properties and application of Asbestos fibre

MODULE - II

2.1.0 Understand the preparation, production, properties and application of Man made fibres
2.1.1. Explain the productionof glass fiber,grades, properties, application and commercially available forms of CSM, Continuous rovings, Woven rovings, Surface mat etc.
2.1.2 Explain the manufacturing of steel fibres with respect to its properties and applications
2.1.3 Explain the preparation, properties and application of viscose rayon, cellulose acetate and cellulose acetate butyrate
2.1.4 Describe the production, composition, structure and properties of carbon fibre and aramid fibre
2.1.5 Explain the preparation, properties, structure and application of Nylon 6, Nylon 66, Polyester, Acrylic, Aramid and Poly olefin fibres.
2.1.6 Define the terms denier, Tex, Tenacity, Filament, Yarn, Strand, Cord, Warp, Wefts, Twist etc.

MODULE - III

3.1.0 Understand various composites and their constituents
3.1.1 Define polymer composites
3.1.2 Describe briefly the history of polymer composites

3.1.3 Describe briefly manufacture of resins like unsaturated poly ester, epoxy, PU, MF, PF with reference to their unique properties and suitability for use in composite products.

3.1.4 Describe the various additives in the process of making composites with special attention to their function and properties (with suitable examples).

3.1.5 Describe the advantage of thermoplastic composites

3.1.6 Describe the Rule of mixtures (ROM)

MODULE - IV

4.1.0 Understand Processing of different composites and moulds

4.1.1 Describe the various moulding techniques like contact moulding, spray lay up, pre preg ,pultrusion, vaccum bag moulding,and pressure bag molding

4.1.2 Describe RRIM, VARIM, RIM,Hot press molding – SMC and DMC, Cold press molding, Resin injection/transfer molding, Preform Molding

41.3 Describe the processof Filament winding and Centrifugal casting in composite products

4.1.4 Hot press molding – SMC and DMC, Cold press molding, Resin injection/transfer molding, Preform Molding and Vacuum injection molding

4.1.5 Describe selection of materials, process and design aspects like section thickness, flanges, corners and inserts

4.1.6 List the materials for FRP molds like POP, Wood, Steel, FRP etc

4.1.7 Explain method of cost calculation of composite products

4.2.0 Understand the manufacture of composite products

4. 2.1 Explain the manufacture of following products and justify selection of resin and reinforcement: / Pedal Boats, Tennis rackets, Helmets, Automobile bodies, Roofing sheets, Bath tubs, Water tanks etc

4. 2.2 Describe the process of casting and coating

4.2.3 List out the various polymer hybrid composite materials (PHBCM) and their production

4.2.4 Describe the nanocomposite materials

COURSE CONTENT

MODULE - I

Natural Fibres: Introduction- Definition of fibres- Importance of fibres in modern life- Structurel variations - fiber ,fiber forming plastics, elastomers. natural fibers- Source, production details, process properties and application of natural fibers like cotton, linen, jute coir and sisal. Commercial importance of other natural fibers such as sisal, flax

Animal fiber- Brief description on silk, wool and other animal hairs

Mineral fibers- Asbestos,

MODULE - II

Man-Made Fibres: Production properties and application of commercially available forms of glass fibres

Production process and application of derived fibres- Viscose rayon

Carbon Fiber: Production, composition, structure and properties of carbon fibre

Production process -wet spinning, dryspinning,melt spinning, properties and application of Nylon 6, Nylon 66, Polyester, Acrylic Aramid, and Polyolefin fibers. Basic terms used in

fiber science such as Denier, Tex, Tenacity, Filament, Yarn, Strand ,Cord, Warp, Weft, Twist.

MODULE - III

Composites and their constituents: Polymer composites, history of composite, manufacture of resins like polyester, epoxy, polyurethanes, MF, PF, UF etc.

Catalyst- initiators- accelerators- Fillers, metal oxides, metallic powders, mineral fillers and mold release agent , thermoplastic resins-PP,PE, ABS,Rule of mixtures

MODULE - IV

Composite molds and Process:

Open molding process- Contact molding, Spray lay up, Wet lay up, Prepregs, Vacuum bag molding,Pressure bag molding etc-Filament winding,Pultrusion,Centrifugal casting.

Process machinery and suitability of hot press molding- SMCand DMC, Cold press molding, Resin injection/ Resin transfer molding, Pre-form molding and vacuum injection molding. Designing of FRP molds and products- Selection of materials, Process and design aspects like section thickness, flanges, corners and inserts.Materials for FRP molds viz plaster of Paris, Wood, Steel, FRP-Cost calculation of composite products**:** Selection of resin and reinforcement for individual products like Pedal Boats, Tennis rackets, Helmets, Automobile bodies, Roofing sheets, Bath tubs, Water tanks -Automobile part like Bumper, DashBoards, Steering Wheels .

Polymer hybrid composite materials (PHBCM)-Processes application and design of nanocomposites-Casting and Coating

REFERENCES:

1. FRP Technology- Wetherhead
2. Man-made fibres- MonCrief
3. Fiber science Ghosh

COURSE TITLE : TYRE TECHNOLOGY
COURSE CODE : PL503
COURSE CATEGORY : B
PERIODS/WEEK : 5
PERIODS/SEMESTER : **80**
CREDITS : 5

TIME SCHEDULE

UNIT		TOPICS	PERIODS
I	1.1	Introduction	2
	1.2	Automobile Tyre , components and their function	6
	1.3	Raw materials used for Tyre manufacturing	6
		Test-I	2
II	2.1	Production of different tyre components	9
	2.2	Understand the building and curing of tyres	7
	2.3	Understand the different steps involved in the production of automobile tube	7
		Test – 2	2
III	3.1	Production of two wheeler and auto tyre	5
	3.2	Re-treading materials	7
	3.3	Cycle tyre and tube	9
		Test – 2	2
IV			
	4.1	Trye testing	7
	4.2	Cycle tyre testing	7
		Test – 4	2
		Total	80

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OBJECTIVES

UNIT – I

1.1.0 Understand the history of the design and development of tyre and illustrate the statistics of tyre products, major industries in India, Rubber consumption pattern & scope

1.1.1 Summarize the history, invention and development of tyre
1.1.2 Summarize statistics relating the production, consumption and export of tyre product
1.1.3 List the major tyre and tyre products manufacturing industries in India and abroad and their collaborators

1.2.0 Define pneumatic tyre

1.2.1 Explain the functions of pneumatic tyre
1.2.2 Understand the different components of pneumatic tyre
1.2.3 Describe the basic tyre construction
1.2.4 Distinguish between bias and radial tyre
1.2.5 Explain the tyre sizing and define aspect ratio
1.2.6 Describe the general system of indicating the dimensions
1.2.7 Describe the different tyre components and their functions with a neat sketch
1.2.8 Important tread design

1.3.0 Understand the raw materials used for tyre manufacturing

1.3.1 Describe tyre reinforcing materials, requirements for tyre cords
1.3.2 Explain the advantages and the disadvantages of cotton, rayon, polyester, nylon, glass, steel and aramid fibers
1.3.3 Explain the raw materials used in various tyre components
1.3.4 Mention the materials used for tyre reinforcement
1.3.5 Describe the auxiliary materials

UNIT-II

2.1.0 Explain the production of tyre components

2.1.1 Explain the production of bead unit ,tyre tread ,inner liner side wall
2.1.2 Design suitable compound for each tyre component based on their final vulcanisate properties, important tread design
2.1.3 Explain the requirements of an adhesive solution for tyre cord
2.1.4 Describe the adhesive (RFL) used for nylon, polyester, and rayon
2.1.5 Explain the different steps involved in fabric processing
2.1.6 Describe the calendaring of fabric and bias cutting in to carcass plies
2.1.7 Define bias angle

2.2.0 Understand the building and curing of tyres

2.2.1 Explain the different parts of tyre building machine used for bias tyre and radial tyre
2.2.2 Define crown height
2.2.3 Explain the different steps involved in the green tyre building of bias and radial tyre
2.2.4 Compare the bias tyre building with radial tyre building
2.2.5 Explain green tyre treatment
2.2.6 Explain BOM press and Autoform press
2.2.7 Explain the curing of bias tyre and radial tyre
2.2.8 Explain PCI
2.2.9 Explain flat spotting and aquaplaning
2.2.10 Describe curing bag, bladder and diaphragm
2.2.11 Describe the functions of curing bladder
2.2.12 Design suitable formulation for curing bladder
2.2.13 Explain the properties required for curing bladder
2.2.14 Explain briefly tubeless tyres

2.3.0 Understand the different steps involved in the production of automobile tube

2.3.1 Describe the functions of inner tube
2.3.2 Design typical compound
2.3.3 Describe different steps involved in the production of automobile tube
2.3.4 Explain tube curing
2.3.5 Explain tube inspection and packaging
2.3.6 Explain the production of tyre flap

UNIT- III

3.1.0 Understand the various components and production of two wheeler, auto tyres and solid tyres

3.1.1 Discuss various components of two wheeler tyres
3.1.2 Explain the production of scooter tyres and auto tyres
3.1.3 Compare solid tyre with pneumatic tyre
3.1.4 List the various field of application of solid tyres
3.1.5 Describe the production of solid tyre with typical formulation
3.1.6 Explain the advantages and disadvantages of solid tyres

3.2.0 Describe the process of manufacture of cycle tyre and tubes
3.2.1 Illustrate the different components of cycle tyre
3.2.2 Explain the two methods of production of cycle tyre – mono band and collapsible drum method
3.2.3 Compare the above two methods
3.2.4 Describe the method of curing of cycle tyre
3.2.5 Explain the methods of manufacture cycle tube
3.2.6 Compare the mandrel curing method with mould curing
3.2.7 Design typical compound for cycle tyre and tube

3.3.0 Understand the process and familiarize the re-treading material
3.3.1 Explain the necessity and importance of re-treading process
3.3.2 List the available re-treading materials – conventional and pre-cured

3.3.3 Explain the process of re-treading by hot and cold processes
3.3.4 Compare hot and cold processes of re-treading
3.3.5 Identify the machinery used for re-treading operation
3.3.6 Design typical compounds for tread, cushion gum and solutions used in hot and cold processes

UNIT –IV

4.1.0 Understand the various tyre-testing systems

4.1.1 Explain the laboratory testing of cords, compound etc.
4.1.2 Explain the laboratory testing of tyres
4.1.3 Explain the non-destructive test such as measurement of dimensions, size factor; tread arc width, non-skid depth and hardness
4.1.4 Explain X-ray, IR, Ultrasonic, microwave, holography, force vibration uniformity
4.1.5 Discuss the high- way test of tyres
4.1.6 Explain the destructive test on tyres like endurance test, plunger test etc.
4.1.7 Explain the cut tyre analysis
4.1.8 Explain the tube testing both destructive and nondestructive

4.2.0 Understand the important test on cycle tyre and tube

4.2.1 Explain denision bend test
4.2.2 Describe the determination of cord strength and casing strength of cycle tyre
4.2.3 Explain the tension set of cycle tyre and tube

CONTENT DETAILS

UNIT-I

Introduction-History on the design and development of tyres –A survey of tyre manufacturing industries –Consumption pattern –statistics –in India and abroad

Automobile tyres- Introduction –pneumatic tyre and its functions – Basic tyre construction- Tyre sizing- aspect ratio and its significance – General system for indicating tyre dimensions – different tyre components of a tyre, its geometry-fuctions.

Raw materials used for tyre manufacturing– Tyre cords - reinforcing materials- their advantages and disadvantages- compounding ingredients

UNIT-II

Production of tyre components–compounds formulation and production of different component of tyre – tread, side wall, bead unit, chafer, flipper, clinch strip, inner liner - production of carcass plies –pre-treatment of tyre cords fabric processing, calendaring, bias cutting into plies

Tyre building machine –both bias and radial tyres building machine –building of green tyres for bias , bias belted and radial tyres –green tyre treatment- tyre curing methods –curing bags,bladder,diaphragms- auto form press,BOM press,PCI-advantages of PCI –typical formulation for curing bags- brief idea of tubeless tyre.

Automobile inner tubes – function –different steps involved in the production of inner tubes – compounding formulation-tube curing –inspection and packaging –Tyre flap

UNIT -III

Production of two wheeler and auto tyres-solid tyre- comparison with pneumatic tyre – advantages and disadvantages.

Re-treading Materials-Introduction – necessity and importance of re-treading – pre-operations -Conventional and pre-cured tread. Different sizes of tread – dimensions -Re-treading process – hot and cold – machinery used for re-treading typical compounds for tread in hot and cold process

Cycle tyre and tubes-Cycle tyre components and their production – cycle tyre building – collapsible drum method and mono band method – curing of cycle tyre – BOM presses – cycle tube – methods of production – mould curing and mandrel curing. Typical formulation for cycle tyre and tube components

UNIT –IV

Tyre testing –Non-destructive and destructive testing of tyre –high way testing

Endurance tests, plunger test-tube testing-**Testing of cycle tyre and tube** – cord strength, casing strength (carcass strength), joint adhesion strength etc.

References:

1. Rubber Technology and manufacturing by C.M.Blow
2. Vanderbuilt Rubber Hand Book –Vander built Rubber Company
3. Tyre Technology –F.J.Kovac
4. Rubber Technology and Manufacturing – Published by SBP
5. IS specification for cycle tyre

COURSE TITLE	**:**	**PLASTIC TECHNOLOGY**
COURSE CODE	**:**	**PL504**
COURSE CATEGORY	**:**	**B**
PERIODS/WEEK	**:**	**5**
PERIODS/SEMESTER	**:**	**80**
CREDITS	**:**	**5**

TIME SCHEDULE

UNIT I	**CONTENTS**	**PERIODS**
	1. INTRODUCTION TO PLASTICS	8
	2.PLASTIC COMPOUNDING	12
	Test – 1	2
UNIT II		
	COMMODITY PLASTICS	18
	Test – 2	2
UNIT III		
	ENGINEERING PLASTICS	18
	Test – 3	2
UNIT IV		
	THERMO SETTING PLASTIC	16
	Test – 4	2
	Total	80

OBJECTIVES

UNIT I

1.1 Understand the importance, history, and statistics of plastics

1.1.1State the importance of plastics in modern life
1.1.2 State the history and evolution of plastics
1.1.3 State the statistics of plastic production, consumption in India
1.1.4 State the advantages of plastics over other conventional materials.
1.1.5 Distinguish 'eccofriendly plastics'
1.1.6Classify plastics according to their temperature response, origin and chemical nature
1.1.7 Define Tg,T_M& T_f. and their determination.

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1.2.0Understand plastic compounding and additives

1.2.1 Mention different compounding ingredients .
1.2.2. Define compounding .
1.2.3. State the function of fillers .
1.2.4 Different type of fillers used in plastic mouldings.
1.2.5 Define coupling agents and its uses
1.2.6. Distinguish plasticizers and lubricants
1.2.7. Give examples of plasticizers and lubricants
1.2.8. Define anti degradents such as anti oxidants ,anti ozonents UV absorbers, flame retardants etc,
1.2.9. Define blowing agents with examples
1.2.10 Define cross linking agents with examples
1.2.11 Give typical formulations of plastic products.
1.2.12 Explain compounding equipments of plastic processing

UNIT II

2.1 Understand different types of commodity plastics

2.1.1. Define commodity plastics
2.1.2 Explain the polymerization of polyethylene by pressure polymerization
2.1.3 Explain Ziegler process and phillip process
2.1.4 Explain the process of manufacturing LDPE, LLDPE, and HDPE
2.1.5 State the properties of different grades of polyethylene
2.1.6 Differenciate low and high molecular weight polyethylene
2.1 7 Define XLDPE and give its application
2.1 8 Explain the industrial production of PP and its application.
2.1.9 Explain the industrial production of PVC and its application
2.1.10 Explain the industrial production of Polystyrene and their application
2.1 11 Explain the industrial production of PMA and PMMA and its application
2.112 Explain the manufacture of HIPS, TPS,ABS etc and their application

UNIT III

3.1.0 Comprehend different Engg. plastics

3.1.1 Mention the monomer of Nylon 6 and Nylon6,6
3.1.2. Distinguish Nylon 6 and Nylon6,6 based on structure
31.3 List out different types of nylon based on numbers
31.4 Illustrate the polymerization of Nylon 6 and Nylon 66
3.1.5. Distinguish the properties of Nylon 6 and Nylon 6,6
3.1.6 Mention the application of nylons.
3.1.5 Describe raw material, industrial production, properties and application of Polycarbonates.
3.1.8 Describe raw material, Polymerization, and application of Polyacetal
3.1.9 Define polyesters
3.1.10 Distinguish between thermo plastics and thermosetting plastics
3.1.11 Describe raw material, industrial production, properties and application of PET, PBT
3.1.12. Compare PET and PBT
3.1.13 State liquid crystal Polyesters

UNITIV

4.1.0 Understand the various thermosetting plastics like MF, UF,PF

4.1.1 Explain the manufacture of PF
4.1.2 Explain the theories of resinification
4.1.3 Mention the applications of PF resins
4.1.4 Explain the manufacture of MF and UF
4.1.5 Mention the applications of MF and U F
4.1.6 Prepare the different formulations of PF moulding powders
4.1.7 Explain the polymerization of Epoxy resin, Polyurethane resin and alkyd resin
4.1.8 Illustrate the curing of thermosetting resins such as MF, UF,PF,epoxy
4.1.9. Prepare different formulations of epoxy resin
4.1.10 State the applications of epoxy.
4.1.11 Describe raw material production, cross linking properties, and application of Silicon Plastics.

CONTENT DETAILS

UNIT I

History of plastics—importance of plastics in modern life –advantages over other conventional materials.,Stastistics,Eccofriendly plastics—Classification based on thermal response, Origin and structure Tg, Tm and T_f of plastics

Plastic compounding, Plastic compounding equipments Additives used in plastics–Fillers,Stabilisers,couplin agents ,Lubricants,Plasticisers,Antidegradents,Blowing agents,Cross linking agents,and typical formulations

UNIT-II

Commodity plastics

Industrial production –Different grades—application of PE -LDPE, HDPE, UHMWPE PP-PS-,PVC-PMMA ,PMA

UNIT III

ENGINEERING PLASTICS

Polyemerisation Different grades –application of following Engg. Plastics Polyamides polyacetals, Polycarbonates, Polyester,Thermoplastic Polyurethane etc

SPECIALITY PLASTICS-PTFE, PC TFE , PPO, PPS.

MISCELLANEOUS PLASTICS-Shellac, casein, bittumine plastics, CI resin.& Cellulose plastics

UNIT IV

Thermosetting plastics-Raw materials— industrial production ,resin manufacturing,moulding powder,properties and applications of MF,UF.,PF EPOXY,ALKYL,SILICON, Thermosetting PU. &UP RESIN

REFERENCES

1. SP Plastic Engineering Handbook of the Society of Plastic Industry - Michael L. Berin
2. Plastic Product Design Engineering Handbook - Sidney Dubou
3. Plastic Materials – J. A. Bridson

4. Plastic Product Design Handbook – Edvard Miller

COURSE TITLE : CHEMICAL ENGINEERING (ELECTIVE)
COURSE CODE : PL 505
COURSE CATEGORY : B
PERIODS/WEEK : 5
PERIODS/SEMESTER : 80
CREDITS : 5

TIME SCHEDULE

UNIT	TOPIC	PERIODS
I.	1.1 Units and dimensions.	10
	1.2.Introduction to Chemical Engineering	8
	Test – I	2
II.	2.1 Understand the mechanism of heat transfer by Conduction and convection	18
	Test – II	2
III	3.1 Understand Material balances in unit operations	18
	Test –III	2
IV	4.1 Understand the Basic Principles of Distillation	18
	Test – IV	2
	Total	80

OBJECTIVES

UNIT - I

1.1.0 Units and dimensions

1.1.1 Explain the various systems of units
1.1.2 Explain the difference between fundamental and derived units
1.1.3 List the fundaments and derived units and SI systems
1.1.4 List the commonly used prefixes and suffixes used in SI systems
1.1.5 Solve problems in conversions of units
1.1.6 Explain the concepts of dimensionless groups
1.1.7 Calculate, using chemical formule, the mass, volume, mole relation, molality, molarity, normality
1.1.8 Define gm atom, kg atom, gm mole, jg mole
1.1.9 Solve problems using atomic weight molecular weight and equivalent weight
1.1.10 Solve problems using mass, volume relationship for gaseous substances
1.1.11 Explain density and specific gravity and specific gravity scales
1.1.12 Solve problems in density and specific gravity
1.1.13 Explain various chemical process in the field of chemical engineering

1.2.0 Introduction to Chemical Engineering

1.2.1 Explain the concept of unit operation and unit process
1.2.2 List the examples of unit operation and unit process
1.2.3 Explain the uses of flow diagram in chemical industries
1.2.4 Prepare flow diagrams for simple process

UNIT –II

2.1.0 Understand the mechanism of heat transfer by conduction

2.1.1 Define conduction
2.1.2 Apply rate equation for heat flow
2.1.3 Derivation of conduction equation for plane well
2.1.4 Define and explain Fourier's law of thermal conduction
2.1.5 Solve the simple problem apply the basic equation of thermal conduction
2.1.6 Define thermal conductivity
2.1.7 Distinguish between steady slate and unsteady state conduction
2.1.8 Derive the equation to calculate heat transfer through composite plane wall
2.1.9 Derive the equation to calculate heat transfer through cylindrical wall
2.1.10 Derive the equation to calculate heat transfer through spherical wall
2.1.11 Solve the problems using equation derived
2.1.12 Explain the different type of insulating materials
2.1.13 Explain the characteristic of good insulating materials

2.2.0 Understand the heat transfer by Convection

2.2.1 Explain convection
2.2.2 Explain the film concept in heat convection
2.2.3 Explain the temperature gradient in forced convection
2.2.4 Define and explain individual heat transfer coefficient
2.2.5 Explain the factors affecting the heat transfer coefficient

UNIT - III

3.1.0 Understand Material balances in unit operations

3.1.1 State law of Conservation of mass
3.1.2 Define the various unit operations like evaporation, distillation,crystallization absorption leaching, extraction
3.1.3 Solve material balance problems involving unit operations like, Evaporation, Distillation, Crystallization, Absorption, Leaching, Extraction
3.1.4 State key component
3.1.5 Solve material balance equations using key component
3.1.6 Solve material balance problems involving bypass and recycle

UNIT –IV

4.1.0 Understand the Basic Principles of Distillation

4.1.1 List the applications of distillation operation
4.1.2 Define the terms less volatile, more volatile, low boiling and high boiling
4.1.3 Express the composition of mixtures of liquid and vapour
4.1.4 Define Raoult's law
4.1.5 Distinguish between ideal and non ideal solutions
4.1.6 Calculate compositions in terms of mole fractions
4.1.7 Construct the vapour – liquid equilibrium diagram for a binary mixture
4.1.8 Calculate vapour liquid equilibrium data applying Raoult's law
4.1.9 Derive an equation for relative volatility
4.1.10 Problems using the above derived equation
4.1.11 Define 'azeotrope'

4.1.12 Explain maximum and minimum boiling azeotrope with suitable examples
4.1.13 List the various methods of distillation
4.1.14 Explain simple distillation
4.1.15 Derive and verify Rayleigh's equation for simple distillation
4.1.16 Explain steam distillation
4.1.17 List the advantages and applications of steam distillation

Content Details

Unit-1

Units and dimensions

Units and dimensions, conversion of units, dimesnsionless group, chemical formulae, mass relation, chemical reactions, gm atom, gm mole, kg atom, kg mole, Relation between mass and volume of gaseous substances . Method of expressing compositions of mixture of solids, liquids and gases, Density, specific gravity and specific gravity scales- Introduction to Chemical Engineering-concept of unit operation and unit process – flow diagrams-Pilot plant study.

UNIT –II

Heat Transfer

Heat transfer by conduction in solids – steady state and unsteady state flow – definition – units of heat flow-Fourier's law of conduction – Rate equation for heat flow – steady state heat flow conduction through single wall – derivation of equation and simple problems – Thermal conductivity – units-Steady state conduction through composite wall in series derivation of equation and problems-Steady state conduction through cylindrical wall and spherical wall derivation – problems

Theory of convection – film concept of heat transfer temperature gradient in forced convection –

UNIT III

Material Balances in unit operations.

Types of processes – Material balances equations – key component - material balances problem involving mixing, leaching, crystallization, evaporation, distillation, absorption – simple problem Involving bypass and recycle.

UNIT–IV

Distillation

Distillation as an interphase mass transfer – industrial application – definition of terms – less volatile, more volatile, low boiling, high boiling – vapour – liquid equilibrium diagrams and their importance. Ideal and non-ideal solutions – Raoult's law – calculation of X-Y data using Raoult's law. Azeotropes –maximum and minimum boiling – volatility and relative volatility – calculation of relative volatility of a binary mixture.Types of distillation – equilibrium – simple distillation, steam distillation,

Reference

1. Process Calculations for chemical engineers - Chem. Engg., Edn Development Centre, IIT Madrass
2. Process Calculations - V.Venkataramani,N.Anantharaman
3. Introduction to Chemical Engineering - Water.L.Badge

4. Heat and Mass Transfer - R.K.Rajputh
5. Unit Operation – I - T.T.T.I. Kalamassery

COURSE TITLE : INJECTION MOULD DESIGN (ELECTIVE)
COURSE CODE : PL 505
COURSE CATEGORY : B
PERIODS/WEEK : 5
PERIODS/SEMESTER : 80
CREDITS : 5

TIME SCHEDULE

UNIT	TOPIC	PERIODS
I.	1.1 Various machine tools used for mould making.	18
	Test – I	2
II.	2.1.0 Steps involved in the construction of mould	9
	2.2.0 Understand Bolsters	9
	Test – II	2
III	3.1.0 Understand the ejection mechanism	9
	3.2.0 Explain the ejection techniques	9
	Test –III	2
IV	4.1.0 Understand the feed system in mould	6
	4.2.0 Understand the Methods adopted for mould cooling	6
	4.3.0 Cooling other mould part	6
	Test – IV	2
		Total 80

OBJECTIVES

UNIT-I

1.1.0 Various machine tools used for mould making

1.1.1 List the various machines used
1.1.2 Brief description of different parts of lathe
1.1.3 Explain the purpose of lathe
1.1.4 Understand turning, boring and facing
1.1.5 Explain the production of a mould using lathe.
1.1.6 Understand the important parts with sketches, purpose and working of machine tools
- 1.1.6.1 Cylindrical grinding machine
- 1.1.6.2 Shaping machine
- 1.1.6.3 Planing machine
- 1.1.6.4 Grinding machine

1.1.6.5 Tracer controlled milling machine

UNIT-II

2.1.0 Steps involved in the construction of mould

2.1.1 Understand the terms
- 2.1.1.1 Impression, cavity and core-Sprue bush
- 2.1.1.2 Runner, gate, register ring, Guide pillars
- 2.1.3 Bushes, fixed half plate, moving half,

2.1.2 Explain the production of cavity and core

2.1.3 Understand core-use of logical inserts, examples

2.1.4 Explain fitting of inserts-multi-impression

2.1.5 Understand mould alignment

2.1.6 Understand designing of logical inserts
- 2.16.1 Core inserts
- 2.1.6.2 Cavity inserts
- 2.1.6.3 Shape and size of inserts

2.2.0 Understand Bolsters

2.2.1 Mention the requirements for bolsters
- 2.2.1.1 Solid bolster
- 2.2.1.2 Strip type bolster
- 2.2.1.3 Frame type bolster
- 2.2.1.4 Chase bolster
- 2.2.1.5 Bolster plate

2.2.2 Explain the ancillary items in mould
- 2.2.2.1 Guide pillars and guide bushes
- 2.2.2.2 Explain the types of guide pillars, materials and fitting.
- 2.2.2.3 Understand the positioning of guide pillars

2.2.3 Explain the Attachment of mould platen-direct and indirect bolting method

2.2.4 Explain briefly the process of casting, Electrodeposition-Cold hobbing-Pressure casting

2.2.5 Understand the steps involved in Bench fitting

UNIT-III

3.1.0 Understand the ejection mechanism

3.1.1 Explain the different ejector systems
- 3.1.1.1 In-line ejector grid system
- 3.1.1.2 Frame-type ejected grid
- 3.1.1.3 circular supported block grid system

3.1.2 Understand ejector plate assembly
- 3.1.2.1 Ejector plate
- 3.1.2.2 Retaining plate
- 3.1.2.3 Guiding and supporting ejector plate assembly
- 3.1.2.4 Ejector rod and ejector rod bush
- 3.1.2.5 Ejector plate assembly return system

3.2.0 Explain the ejection techniques

3.2.1 Understand the different methods of ejection

3.2. 2 Explain the various ejection techniques.
- 3.2.2.1 Pin ejection
- 3.2.2.2 Stepped ejection pins
- 3.2.2.3 D-shaped ejector pin

3.2.2.4 Sleeve ejection
3.2.2.5 Blade ejection
3.2.2.6 Valve ejection
3.2.2.7 Air ejection
3.2.2.8 Stripper bar ejection
3.2.2.9 Stripper plate ejection
3.2.3 Explain the ejection from fixed plate
3.2.4 Understand the Sprue pullers.

UNIT-IV

4.1.0 Understand the feed system in mould
4.1.1 Describe runner in injection mould design
4.1.1.1 Understand the cross-section, runner layout, shape and size of runner
4.1.1.2 Explain the factors affecting runner layout
4.1.2 Define gate.
4.1.3 Explain the different gate
4.14 Explain the positioning and balancing of gate
4.1.5 Empirical relationship for gate depth.
4.1.6 Explain location of parting surface.Give brief explanation of the following parting surface
4.1.6.1 Flat parting surface
4.1.6.2 Non-flat parting surface
4.1.6.3 Stepped parting surface
4.1.6.4 Profiled parting surface
4.1.6.5 Angled parting surface
4.1.6.5 Complex edge form
4.1.6.6 Stepped parting surface
4.1.6.7 Profiled parting surface
4.1.6.8 Angled parting surface
4.1.6.8 Complex edge form-
4.1.6.9 Balancing of mould surface

4.2.0 Understand the Methods adopted for mould cooling

4.2.1 Cooling integer type mould plates
4.2.2 Cooling integer type cavity plate
4.2.3 Cooling integer type core plate
4.2.4 Cooling insert-bolster assembly-cooling bolster
4.2.5 Cooling cavity inserts, cooling circular insert, cooling core inserts-

4.3.0 Cooling other mould part
4.3. 1 Cooling valve-type ejection.
4.3.2 Cooling the the sprue bush-Water connections-adaptors,quick connection adaptors

CONTENT DETAILS

UNIT-I

Machines tools used for mould making

Lathe-important part, Primary purpose, turning, boring and facing-Mould part produced on lathe-Steps involved in the manufacture of a typical mould part-**Cylindrical grinding machine-**important parts with sketches-working-**Shaping machine-**purpose, working-**planing machine-**working –**Surface -**important parts with sketches, purpose, and working of **Milling machine**, **grinding machineand tracer-controlled milling machine**

UNIT-II
Mould construction

Basic terminology-Impression, cavity and core-Sprue bush, runner, gate, register ring, Guide pillars& bushes, fixed half plate, moving half,-Manufacture of cavity and core-use of logical inserts, examples-fitting of inserts-multi-impression-mould alignment-Bolsters-different types-Ancillary items-designing of guide pillars,positioning –Attachment of mould platern-Casting-Electrodeposition-Cold hobbing-Pressure casting-Bench fitting

UNIT-III

Ejector systems-ejector grid- different types, in-line, frame-type and block grid-Ejector plate assembly-ejector plate, retaining plate, plate assembly return system, stop pin-Ejection techniques –different methods, pin ejection, stepped ejection pins, D-shaped ejector pin, sleeve ejection, blade ejection, valve ejection, air ejection, stripper bar ejection, stripper plate ejection- different methods, stripper ring ejection-Ejection from fixed plate-Sprue pullers.

UNIT-IV

Feed System-Runner, cross-section shape, size-Runner layout, factors affecting layout-Gate, requirements-Positioning of gate-Balanced gating-Types of gate-Empirical relationship for gate depth

Parting Surface-flat parting surface, non-flat parting surface-stepped parting surface, profiled parting surface, angled parting surface, complex edge form-Balancing of mould surface-Venting

Mould Cooling-cooling integer type mould plates-cooling integer type cavity plate, cooling integer type core plate-Cooling insert-bolster assembly-cooling bolster, cooling cavity inserts, cooling circular insert, cooling core inserts-Cooling other mould part-Cooling valve-type ejection, cooling the the sprue bush-Water connections-adaptors,quick connection adaptors

Reference

1	Injection Mould design	- R.G.W.Pye
2	Plastic Product design	-Ronald.D.Beck
3.	Design plastic moulds and dies	-LASZLO SRS & IMREBALZS

COURSE TITLE	**:**	**COMPOSITE LAB**
COURSE CODE	**:**	**PL506**
COURSE CATEGORY	**:**	**P**
PERIODS/WEEK	**:**	**3**
PERIODS/SEMESTER	**:**	**48**
CREDITS	**:**	**2**

DETAILS OF LABORATORY WORK IN COMPOSITE LAB

1.0 Testing of Fibre

1.1.Determination of Denier
1.2.Determination of Tex
1.3.Determination of Tenacity
1.4.Determination of Elongation at Break
1.5. Determination of Linear Density

2.0 Testing of Resin

2.1 Gel time determination
2.2 Determination of set time
2.3 Determination of cure time

3.0 Production of composite products

3.1 Production of castings
3.2 Production of hand laid products (single layer, double layer Inner finished & outer finished)

4.0 Production of plastic products

4.1 Compression molded products
4.2 Blow molded products
Injection molded products
Extruded products
4.3 Screen printing
4.4 Production of poly urethane foam products

5.0 Testing of Plastics & Composite products

5.1 Ignition loss of composite material
5.2 Voids content of composite material
5.3 Determination of dimensions, density, visual defects water absorption, swelling

Marks

Internal	50
External	50
Total	100

COURSE TITLE : PRODUCT TESTING LAB
COURSE CODE : PL507
COURSE CATEGORY : p
PERIODS/WEEK : 3
PERIODS/SEMESTER : 48
CREDITS : 2

DETAILS OF LABORATORY WORK IN R PRODUCT TESTING LAB

1. Conduct specification tests on the following polymer products
    1) Cycle tyre
    2) Cycle tube
    3) Automobile tyres
    4) Examination gloves
    5) Surgeon's gloves
    6) Latex foam
    7) Electric wires
    8) Plastic containers
    9) Some automobile components made from rubber, plastics and composites
    10) Any other Polymer products having specifications

Physical testing of Polymer Specimens

1 Determination of Tensile properties of rubber vulcanisate.
2 Determination of Tension Set.
3 Determination of Compression Set
4 Determination of Tear strength.
5 Determination of Hardness
6 Determination of Abrasion resistance
7 Determination of Resilience
8 Determination of impact strength
9 Determination of Mooney viscosity and cure characteristics
10 Determination of cure time using rheometer
11 Accelerated ageing testing.
12 Determination of cut growth resistance by the use of Ross flexing machine
13 Determination of Tensile properties of plastics and composites.
14 Determination of Heat distortion temperature
15 Determination of flexural strength.
16 Determination of compressive strength.
17 Determination of MFI

Marks

Internal	50
External	50
Total	100

COURSE TITLE	: **PROJECT WORK &SEMINAR**
COURSE CODE	**: PL5, 6**
COURSE CATEGORY	**: Pr**
PERIODS/WEEK	**: 2**
PERIODS/SEMESTER	**: 32**
CREDITS	**:**

PART – I Seminar
Objective:
Develop Presentation skills,

Exposure to an innovative area of information

Subject Select an interesting subject which shall be a supporting subject other than curriculum.

Presentation: - Presentation shall be at least 15 minutes

Discussion: Question answer and further clarification, checking of depth of knowledge by faculty
members etc included in discussion, time at least 5 minute

Report: A rough report of the seminar content shall be submitted at least 3 working days before
presentation and a fair report shall be submitted before one week after presentation.

PART – II Project work

Objectives
1. To enhance team spirit for achieving a goal
2. To impart creative talents
3. To create practical sense in implementing a project
4. To impart management skills required for functioning as a middle management resource
5. To impart social commitments

Activity
I. Select an activity among any of the class
1. Produce a production system or model for any of the polymeric product
2. Introduce a new system of effective running of practical (eg:
Arrangements)
3. Any development work connected with the Institution (Eg: conduct an
exhibition, start a library, create a rubber garden etc)

II. Materialize the project and take trials or implement

III. Prepare a report comprises scope, observations, estimations, implementation plan, diary of activity, results.

URSE TITLE : INDUSTRIAL TRAINING
COURSE CODE : PL509
COURSE CATEGORY : Pr
PERIODS/WEEK :
PERIODS/SEMESTER : 2 weeks
CREDITS :

DETAILS OF INDUSTRIAL TRAINING

Objective: Familiarize the real product manufacturing systems

Conditions &Activity

Each student has to identify with the guidance of faculty members an Industry with not less than 50 persons working in production and production rate atleast 5 tone/month". They shall submit a
Training report.
Duration –two week

Evaluation statement

Continuous Evaluation-50

Marks	
Attendance	10
Industry feed back	10
Maintenance of Training dairy/Daily report	10
Bonafied Training Report	10
Viva-Voce	10
Total	**50**