SUMMER-19 EXAMINATION

Model Answer

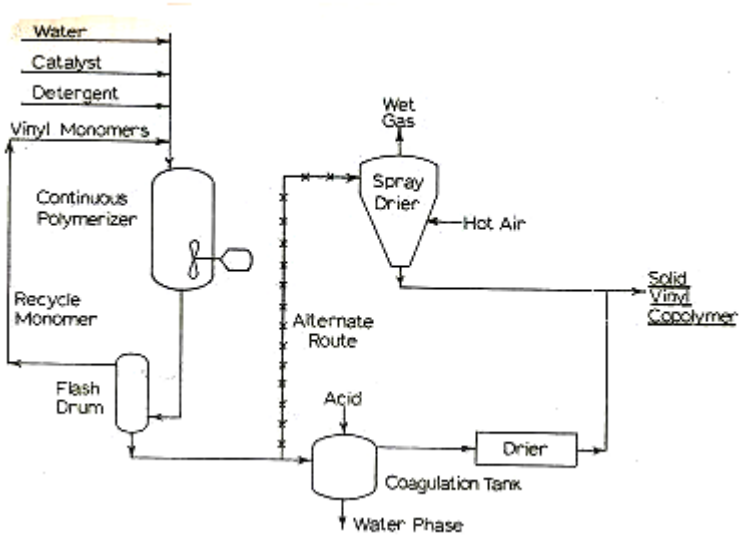
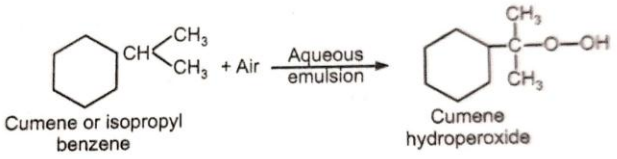
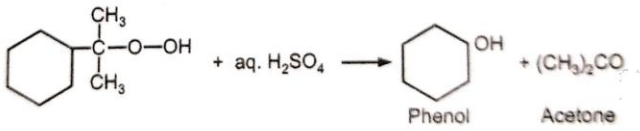
Subject Name: Technology of organic chemicals **Subject Code:** 22410

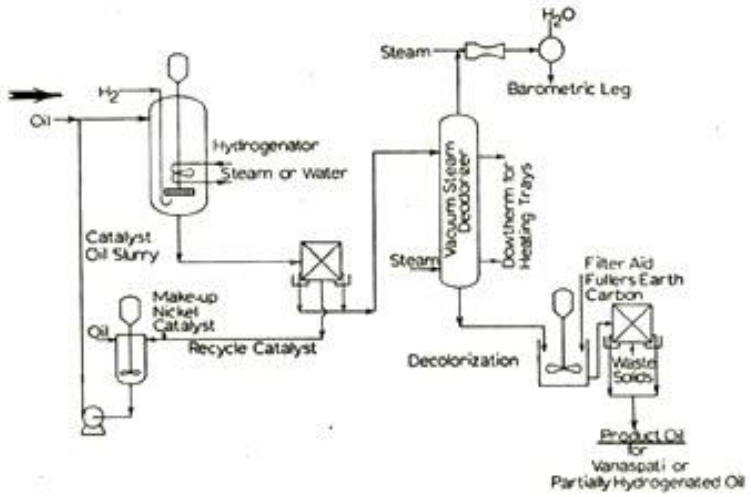
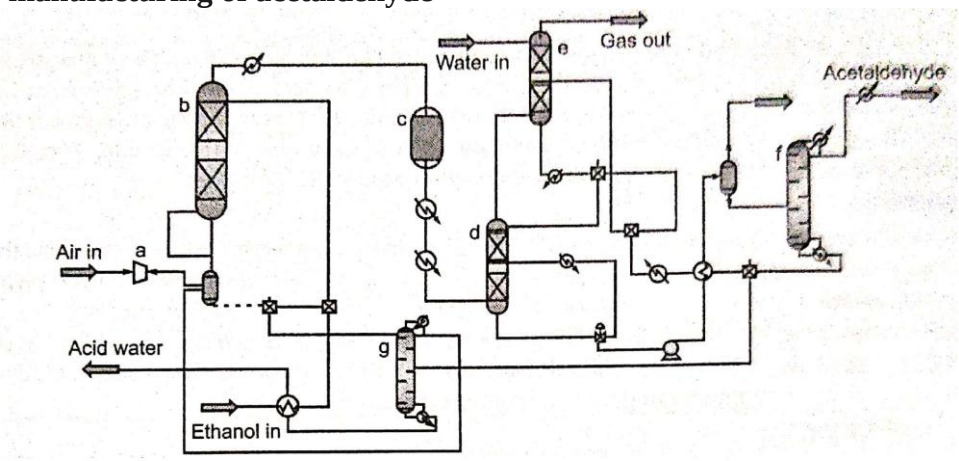
Important Instructions to examiners:

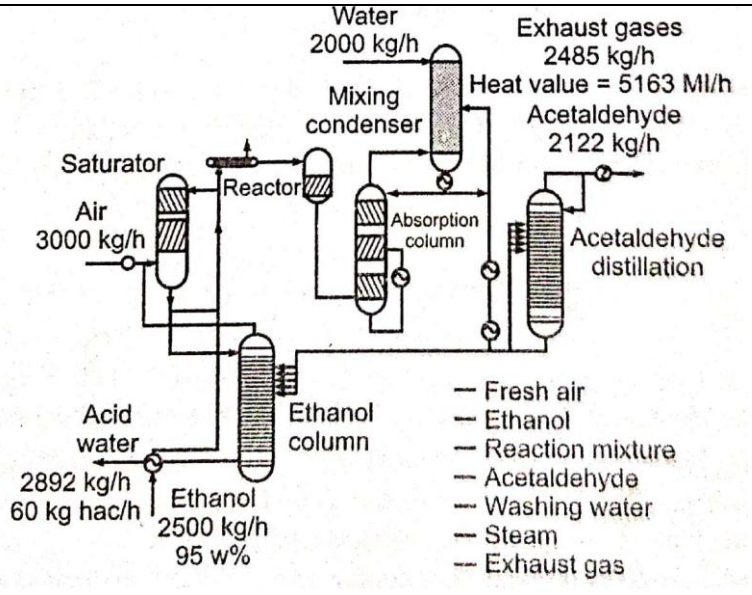
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No	Sub Q. N.	Answer	Marking Scheme
1.		**Attempt any Five of the following**	**10**
	a)	**Uses of ethyle acetate** • As a solvent. • In paint as a hardener • In perfumes • An effective asphyxiant for use in insect collecting and study.	½ mark each
	b)	**Chemical reactions involved in the mfg. of alcohol from molasses** Invertase $C_{12}H_{22}O_{11}$ ----------> $C_6H_{12}O_6 + C_6H_{12}O_6$ sucrose yeast Glucose fructose zymase $C_6H_{12}O_6$ ---------→ $2\ C_2H_5OH + 2CO_2$ Glucose yeast alcohol	1 1
	c)	**Uses of vegetable oil** • Cooking	1 mark each for any two

		• For manufacturing of hydrogenated fats • For manufacturing of soap • For manufacturing of fatty acid • In medicine • For production of biodiesel • In paint manufacturing	
	d)	**Raw materials for polycarbonate** • Bisphenol-A • Phosgene (carbonyl chloride)	1 mark each
	e)	**Raw material for Pulp** • Cellulose from bamboo, bagasse or wood etc • Cooking liquor (lime + Na_2SO_4)	1 mark each
	f)	**Industrial applications of Polyethylene** • Household utensils • Packaging films • Tubes • Cable sheeting • Storage tanks	1 mark each for any two
	g)	**Various Methods for phenol manufacturing** 1. Cumene peroxidation – hydrolysis 2. Toluene two – stage oxidation. 3. Rasching : vapour phase hydrochlorination & hydrolysis. 4. Chlorobenzene - caustic hydrolysis. 5. Benzene sulfonate – caustic fusion. 6. Benzene – direct oxidation.	1/2 mark each for any four
2.		**Attempt any THREE of the following**	**12**
	a)	**Constituents of paint** **Pigments: -** It is finely divided solids generally made up metal oxides .It is used to give color to paint. **Drying oil: -** These are unsaturated oils. It is used to form protective film and give gloss.	1 mark each

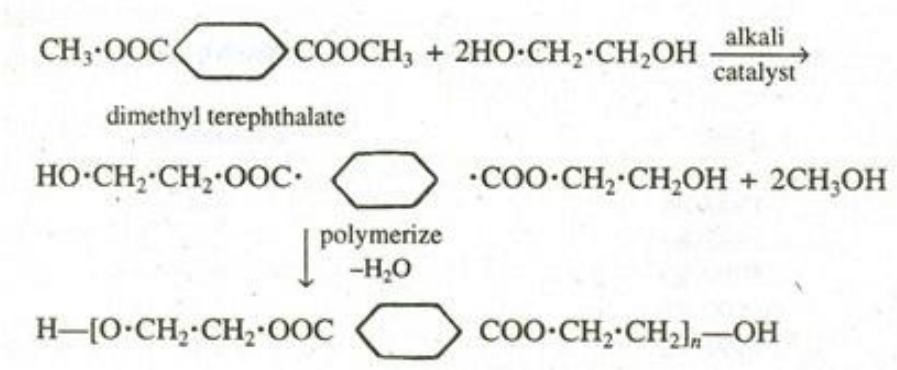
		Thinners or solvent: - It is alcohols or turpentine. is used to dissolve polymers in paint and to disperse pigments (emulsion formation).It adjust viscosity, form thin film. **Plasticizer: -** These are polymers. Used to impart elasticity to paint.	
	b)	**PFD of Polyvinylchloride**  	4
	c)	**Reactions involved in manufacturing of Phenol from Cumene** **(a) Peroxidation :**  **(b) Hydrolysis :**  	4
	d)	**Hydrogenation of Oil** The dry pure oil and nickel catalyst is taken in an iron cylinder. The cylinder has two inlets & outlets. One inlet is used for the introduction of oil & the other to introduce dry hydrogen. Unused hydrogen is removed through the upper outlet, while lower outlet is used to take the hydrogenated oil. The cylinder is provided with stirrer inside it. The temp. is regulated between1400C-180oC. From the second inlet, pure hydrogen gas is well mixed	4

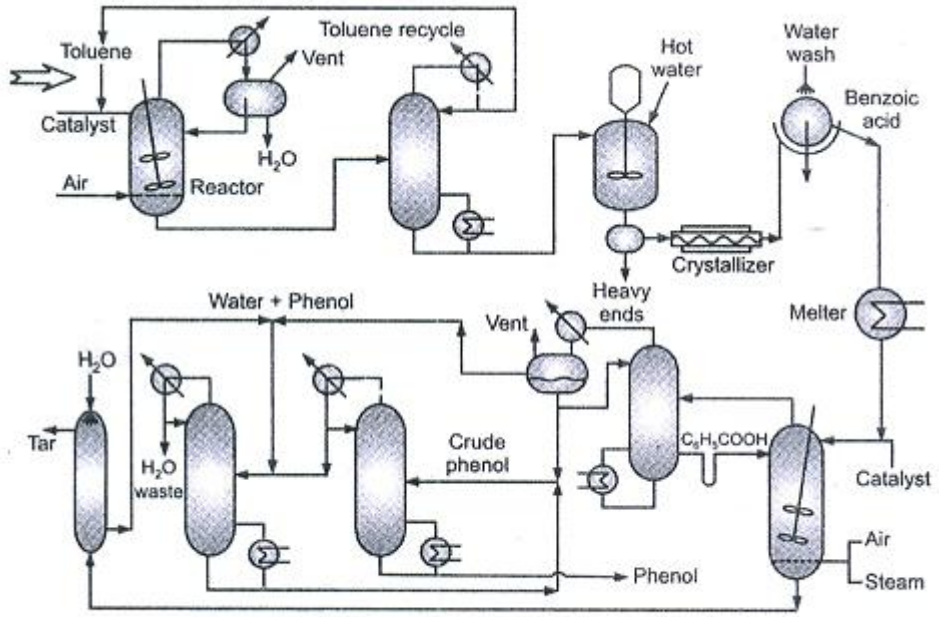
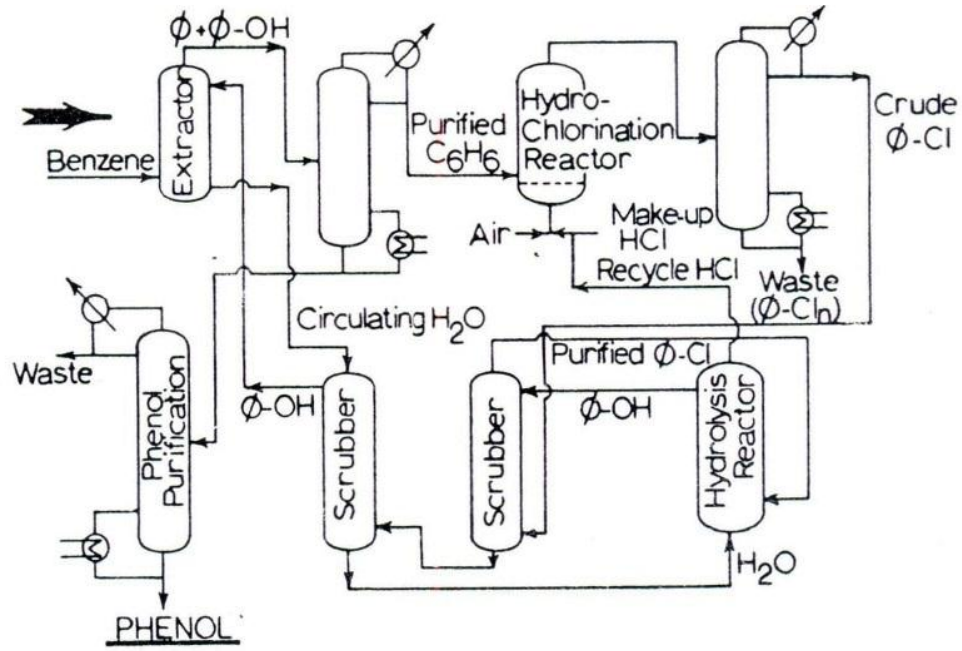
		with the oil. In the cylinder oil &dry hydrogen gas are well mixed with mechanical stirrer. After certain time a sample of hydrogenated oil is taken through outlet is situated at the bottom of the cylinder. The iodine value of the hydrogenated oil is determined. If it is 60, the process of hydrogenation is stopped. And all the hydrogenated oil is taken out It is passed through cooler then filter pressed to remove nickel particles.  	
3.		**Attempt any THREE of the following**	**12**
	a)	**PFD for manufacturing of acetaldehyde**  **OR**	4

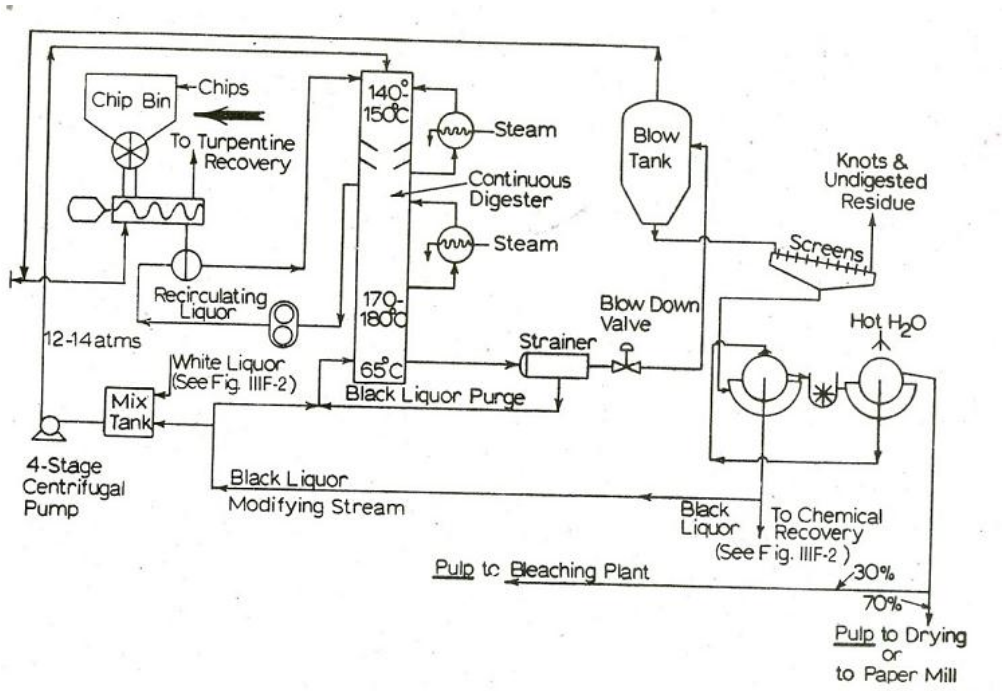
			
	b)	**Manufacturing of detergents**. The alkyl benzene is introduced continuously into sulfonator with the requisite amount of oleum, using the dominant batch principle. To control the heat of sulphonation conversion and maintain the temperature at about 55^{o}C. Into the sulfonation mixture is fed the fatty alcohol and more of the oleum. All are pumped through the sulfater , also operating on the dominant bath principle to maintain the temperature at 50-55^{o}C, thus manufacturing a mixture of surfactants. The sulfonated –sufated product is neutralized with caustic solution under controlled temperature to maintain fluidity of the surfactant slurry. The surfactant slurry, the sodium triphosphate, and most of the miscellaneous additives are introduced into the crutcher. A considerable amount of water is removed , and the paste is thickened by the tripolyposphate hydration reaction. This mixture is pumped into an upper story, where it is sprayed under high pressure into 24 meter high spray tower , counter to hot air from furnace. Dried granules are transferred to an upper story again by an air lift which cools them from 115^{o}C and stabilizes the granules. The granules are separated in cyclone separator, screened, perfumed and packed. **OR** Molten sodium is added slowly to coconut oil in an aliphatic solvent plus esterifying	4

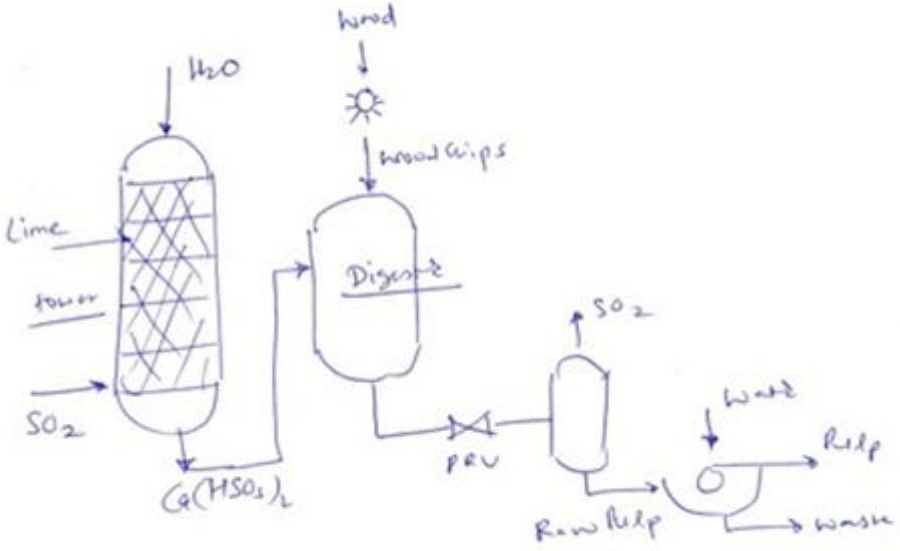
<table>
<tr><td></td><td></td><td>alcohol such as amyl alcohol. After certain time reaction is completed. The batch is pumped into a water tank where mixture settles into three layers, the top is the high molecular weight alcohols, the intermediate layer contains regenerated reducing alcohol, and the bottoms have caustic soda and glycerin for recovery. Lauryl alcohol is reacted with sulfuric acid to get sulfated fatty alcohol. It is one type of synthetic detergent.</td><td></td></tr>
<tr><td></td><td>c)</td><td>Difference between paint and varnish
<table>
<tr><th>Paint</th><th>Varnish</th></tr>
<tr><td>Paint is the mechanical dispersion mixture of one or more pigments in a vehicle.</td><td>Varnish is a homogenous colloidal dispersion solution of resin in oils or thinner or both.</td></tr>
<tr><td>A paint contains pigment.</td><td>Varnishes do not Contain Pigments.</td></tr>
<tr><td>Paint Produce an opaque film.</td><td>Varnish produces transparent film.</td></tr>
<tr><td>In paints pigments are dispersed in drying oils.</td><td>In varnishes resins are dispersed in oils or spirits.</td></tr>
</table></td><td>1 mark each</td></tr>
<tr><td></td><td>d)</td><td>Manufacturing of pulp from kraft process
The wooden chips are metered via star valve to a deaerator preheater . After several minutes, the chips are discharged through a rotating tapered plug into the lift line where recirculating digestion liquor at 12 atms. Transfers chips to the upper soaking zone of the 25-30m tall digester tower.
Chips flow down past a series of circumferential screen plates. Cooking liquor is withdrawn as side streams and circulated through external heat exchangers to reheat and control the digestion temp. within the tower.
The digestion time and temp. is adjusted so that max lignin removal is accomplished with a minimum cellulose hydrolysis and consequent loss of bulk yield.
The digested chips are cooled at the base of tower by injection of cold black liquor. This is to avoid mechanical weakening of fibers from steam explosion of hot liquor when passed through a blow down valve. The pulp liquor slurry is passed through the valve to a blow tank where residual heat is recovered in the form of steam. which passes overhead with turpentine vap. To the chip preheater. The pulp is filtered to separate black liquor and</td><td>4</td></tr>
</table>

		screened to remove wood knots and other undigested residue. **OR** **Manufacturing of pulp from sulphite process** In this process wood chips are charged into digester . The cooking liquor is prepared by absorbing SO_2 into into tower packed by limestone to which water is fed from the top. The following reaction takes place. $SO_2 + H_2O = H_2SO_3 + Q$ $2H_2SO_3 + CaCO_3 = Ca(HSO_3)_2 + CO_2 + H_2O + Q$ The aqueous solution of calcium bisulphate is the saturated with sulfur trioxide. The acid liqueur contain bisulphate and H_2SO_3 . The wood cooking removes maximum amount of hemicelluloses and lignin and keep cellulose intact. After cooking pressure in the digester is reduced. SO_2 escaped is recovered and reused. The contents in digestor are washed and unreacted material is separated from pulp.	
4.		**Attempt any THREE of the following**	**12**
	a)	**Soap by continuous process** Glycerides plus catalyst are added at the bottom of the hydrolysis tower where high pressure water at 230-250oC is passed countercurrently to the glycerides. And triglycerides are brake into fatty acid and glycerin with a 15-20% glycerin solution being removed from bottom of the tower. The fatty acid is passed overhead to a flash tank to remove excess steam. The crude fatty acid are vacuum distilled and the condensate in the distillate receiver is either available as a marketable product or for soap mfg. Caustic soda is added to fatty acid in a continuous high speed mixture and the saponification is completed in a slow speed blender where other ingredients are added if desired. Soap from the blender may be pumped through heated lines to bar soap or flake or spray drying equipments followed by packing operations. **Hot Process :** Glycerides plus catalyst are added at the bottom of the hydrolysis tower where high pressure water at 230-250oC is passed counter currently to the glycerides. And triglycerides are brake into fatty acid and glycerin with a 15-20% glycerine solution being removed from	4

		bottom of the tower. The fatty acid is passed overhead to a flash tank to remove excess steam. The crude fatty acid are vacuum distilled and the condensate in the distillate receiver is either available as a marketable product or for soap mfg. Caustic soda is added to fatty acid in a continuous high speed mixture and the saponification is completed in a slow speed blender where other ingredients are added if desired. Soap from the blender may be pumped through heated lines to bar soap or flake or spray drying equipment's followed by packing operations. (Marks should be given for any other process also)	
	b)	**Paint manufacturing industries** 1. Asian Paints – (Mumbai)Maharashtra, (Gautam Budh Nagar)UP, (Medak)Telangana, (Ankleshwar)Gujarat 2. Berger Paints – (Hawrah)West Bengal. Pondicherry, Goa 3. Nerolac Paints – (Hosur)Tamilnadu, (Kanpur)UP, (Chiplun)Maharashtra 4. Akzo Nobel – (Hyderabad)Telangana, (Mohali)Punjab, (Navi Mumbai)Maharashtra	1 mark each
	c)	**Reactions involved in polyester manufacturing**  	4
	d)	**PFD- Phenol manufacturing by toluene oxidation**	4

		 **Flow sheet for manufacturing of Phenol from Toluene oxidation**	
	e)	**Manufacturing of Phenol by Raschig process** 	4
5.		**Attempt any TWO of the following**	**12**

	a)	**Manufacturing of pulp from kraft process** The wooden chips are metered via star valve to a deaerator preheater . After several minutes, the chips are discharged through a rotating tapered plug into the lift line where recirculating digestion liquor at 12 atms. Transfers chips to the upper soaking zone of the 25-30m tall digester tower. Chips flow down past a series of circumferential screen plates. Cooking liquor is withdrawn as side streams and circulated through external heat exchangers to reheat and control the digestion temp. within the tower. The digestion time and temp. is adjusted so that max lignin removal is accomplished with a minimum cellulose hydrolysis and consequent loss of bulk yield. The digested chips are cooled at the base of tower by injection of cold black liquor. This is to avoid mechanical weakening of fibers from steam explosion of hot liquor when passed through a blow down valve. The pulp liquor slurry is passed through the valve to a blow tank where residual heat is recovered in the form of steam. which passes overhead with turpentine vap. To the chip preheater. The pulp is filtered to separate black liquor and screened to remove wood knots and other undigested residue.  	3 3

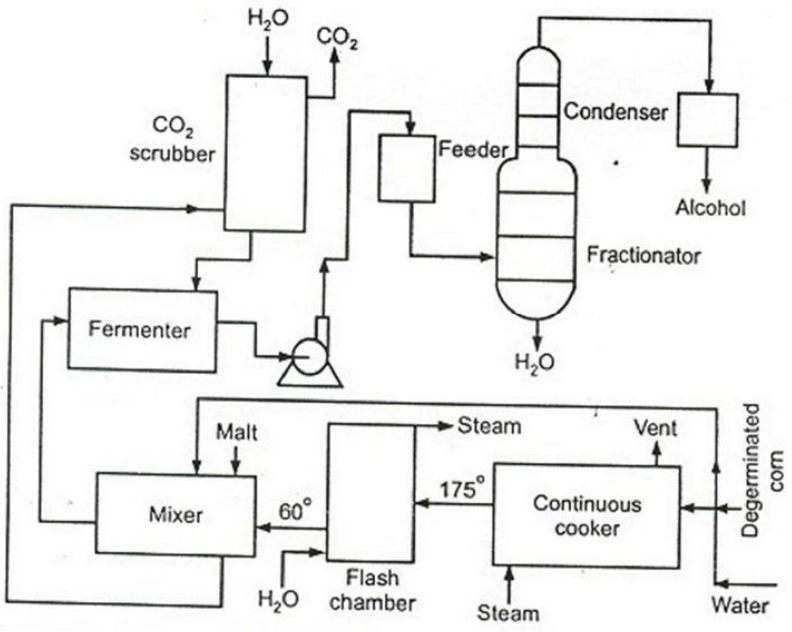
		OR **Manufacturing of pulp from sulphite process** In this process wood chips are charged into digester . The cooking liquor is prepared by absorbing SO_2 into into tower packed by limestone to which water is fed from the top. The following reaction takes place. $SO_2 + H_2O = H_2SO_3 + Q$ $2H_2SO_3 + CaCO_3 = Ca(HSO_3)_2 + CO_2 + H_2O + Q$ The aqueous solution of calcium bisulphate is the saturated with sulfur trioxide. The acid liqueur contain bisulphate and H_2SO_3 . The wood cooking removes maximum amount of hemicelluloses and lignin and keep cellulose intact. After cooking pressure in the digester is reduced. SO_2 escaped is recovered and reused. The contents in digestor are washed and unreacted material is separated from pulp.  	
	b)	**Ethyl alcohol from corn** Raw materials: Corn, Diastase, maltase, zymase Reactions:	2

$2\ (C_6H_{10}O_5)_n + n\ H_2O \xrightarrow{Diastase} n\ C_{12}H_{22}O_{11}$

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{Maltase} 2\ C_6H_{12}O_6$

Fermentation reaction

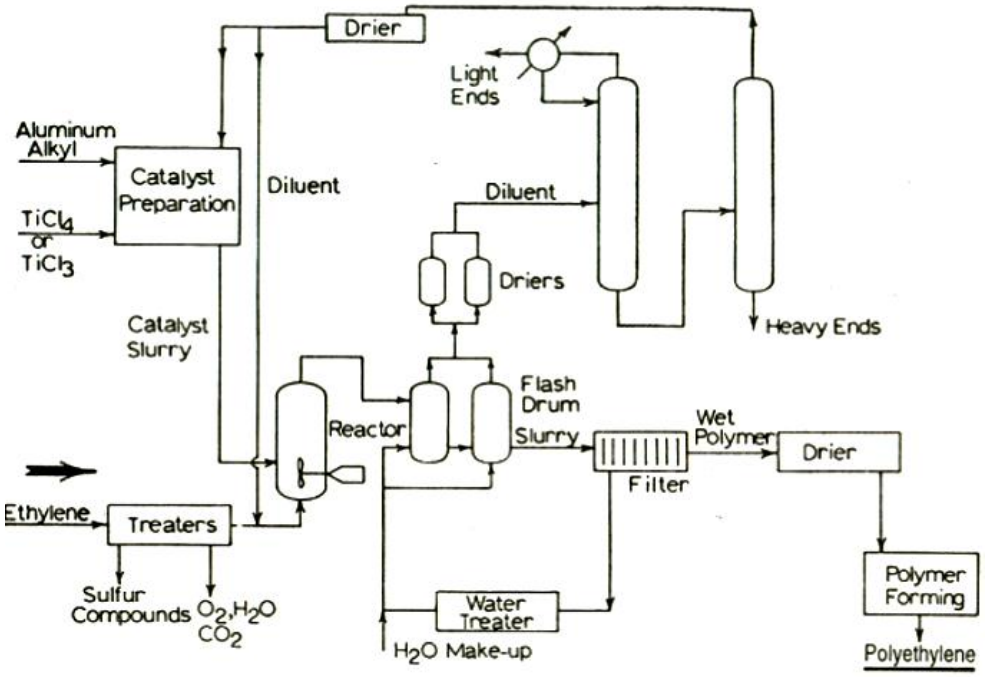
$C_6H_{12}O_6 \xrightarrow{Zymase} C_2H_5OH + 2\ CO_2$

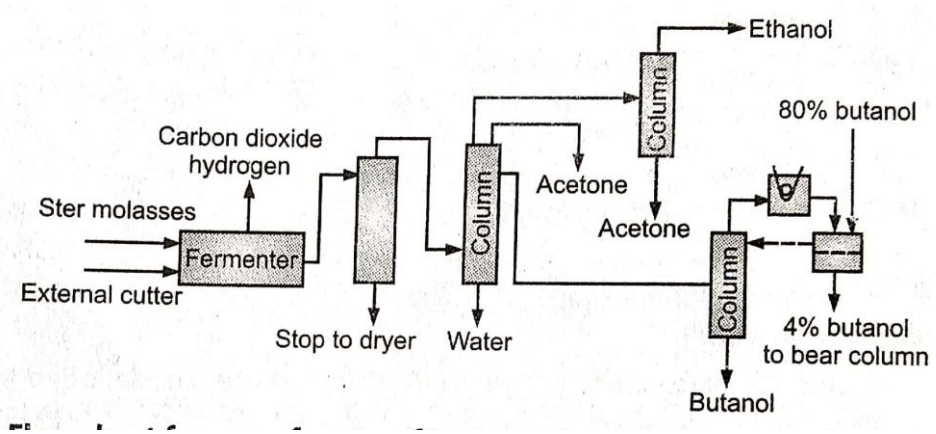


2

The corn is fed to cooker, cooker is necessary to gelatinize the ground grain so that the barley malt amylase can convert the starch to fermentable sugars. The cooker may be batch or continuous and are operated under pressure. In continuous process grain is precooked for 1 to 5 min with water. The mass is continuously fed to steam heater that instantaneously raises temperature to 175deg C. The mass is passed through series of pipes and discharged through a relief valve into flash chamber. Time in cooker is about1.5 min and pressure is maintained at 60 to 100 gauge. The temperature of mass drops to about 60 deg C in flash chamber.

2

		The coked grain mass is missed with malted barley and water and this is send to fermentator. The gases during fermentation are scrubbed by using water and send to series of rectification column and the condensation product is nothing but alcohol.	
	c)	**Ziegler process for the manufacturing of polyethylene**  **Reaction** $nC_2H_4 \longrightarrow -[CH_2-CH_2]-_n$	4 2
6.		**Attempt any TWO of the following**	**12**
	a)	**Applications of butanol (any three)** • As a fuel • As a solvent • For production of ether • Plasticizer • Butyl acrylate • N butyl acetate • Glycols	1 mark each for any three

		Block diagram of Butanol manufacturing 	3
	b)	**Industrial applications of Poly vinyl chloride** • Pipes • Raincoats • Cables • Vinyl flooring • Packaging • Healthcare **Industries manufacturing PVC** • Finolex industries (Ratnagiri) • Chemplast (Cuddalore) • Reliance (Hazira) • DCW (Tuticoron) • DCM Shreeram (Kota)	1 mark each for any two 1 mark each for any four
	c)	**Uses of phenol** for production of • formaldehyde • epoxy resins • herbicides, • insecticide	1 mark each for any two

		• In pharmaceutical industry **Industries manufacturing Phenol** • SI Group India Ltd • HOC • Deepak Phenolics Ltd. • Prasol Chemicals Pvt. Ltd.	1 mark each