Calculate the standard heat of reaction  $\Delta H_r$  of the following:  $C_2H_5OH(1) + CH_3COOH(1) = C_2H_5OOCCH_3(1) + H_2O(1)$ 

Heats of combustion are as follows:

C <sub>2</sub> H <sub>5</sub> OH	$\Delta H_{c} = -326,700 \text{ cal}$
CH <sub>3</sub> COOH	$\Delta H_{c} = -208,340$ cal
C <sub>2</sub> H <sub>5</sub> OOCCH <sub>3</sub>	$\Delta H_{c} = -538,760$ cal

arbon monoxide at 200° C is burned under atmospheric pressure with dry r at 500° C in 90% excess of that theoretically required. The products of ombustion leave the reaction chamber at 1000° C. Calculate the heat volved in the reaction chamber in kilo calories per kilogram mole of CO urned assuming complete combustion. (The mean specific hear of CO, air,  $D_2$ ,  $O_2$  and  $N_2$  are 7.017, 7.225, 11.92, 7.941 and 7.507 kcal/kg-moles spectively.)

moles of liquid air is stored in a vessel at atmospheric pressure. Heat ks through the vessel walls so that vaporization occurs. Under these iditions the relative volatility of  $N_2$  to  $O_2$  may be taken as constant at 2:1. culate the moles of liquid left in the vessel, when the residual liquid aposition is 50 mole % nitrogen and 50 mole % oxygen.

en 1.0g of naphthalene ( $C_{10}H_8$ ) is burned in an oxygen-bomb primeter, with all water formed during the combustion of the naphthalene ig condensed, 40.28 kJ are evolved at 25° C. Calculate the gross heating is and the net heating value of naphthalene at constant pressure and 25° he latent heat of vaporization of water at 25° C is 44.05 kJ/g-mole.

with the necycled gas and enters in the reactor with the compositio 79.52% He. The gas leaving the aminorial selection contains 20.01% He<sup>a</sup>un amateura the product attimonial loss not contain dissolved gas as Base 100 anot these first citiculate the kind for clear the plaged and platornession of hydrogen (All percentages are by mole) Mechanical Operations (CHEN 2101)

Full Marks : 70

(d) 0.65.

F

JT

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and (5 (five) from Group B to E, taking <u>at least one</u> from each group.

whether are required to give answer in their own words as far as practicable.

Group – A (Multiple Choice Type Questions) use the correct alternatives for the following: afine screening refers to screening a feed of size-range above 4 mesh above 4 mesh below 48 mesh (d) none of these. 10 x 1=10

he value of sphericity for cube is (b) 1 (c) 1.75

idenergy mill is a (a) Crusher (c) Ultrafine grinder

5

10

7

8

tted : 3 hrs

(b) Grinder (d) None of these.

(a) Toothed roll crushers (c) Smooth roll crushers

(b) Impactors (d) None of these.

<sup>limentor</sup> is called clarifier when the desired product is <sup>a)</sup>Concentrated sludge <sup>c)</sup>Clear liquid (d) Both a and b.

<sup>Alk</sup>law is more applicable for fine grinding? <sup>Alk</sup>littinger's law <sup>CB</sup>Bond's law (d) All of these.

<sup>onnection</sup> with froth floatation, pine oil is a Prother (b) Modifier Collector (d) None of these.

1

 $h_{\rm h}^{\rm rat is}$  the unit of filter medium resistance? (b) m<sup>-1</sup> (c) m<sup>-2</sup>

3063

(d) None of these

### ech/CHE/Odd/Sem-3

Calculate the standa  $C_{2}H_{5}OH(1) + C$ Heats of combustion C<sub>2</sub>H<sub>5</sub>OH CH<sub>3</sub>COOH C<sub>2</sub>H<sub>5</sub>OOCCH<sub>3</sub>

Carbon monoxide a air at 500° C in 90 combustion leave evolved in the read burned assuming co CO<sub>2</sub>, O<sub>2</sub> and N<sub>2</sub> a respectively.)

50 moles of liquid leaks through the conditions the relat Calculate the mole composition is 50 n

When 1.0g of n calorimeter, with a being condensed, 4 value and the net h C. The latent heat of

D.ILU	H/CHE/3rd SEM /	CHEN 2101	/2015			HE/3rd SEM /CHEN 2101/2015	
(ix) Ef	ffect of system geor	netry in agita	ated vessels is	expressed in	n the form of	(6) + (4+2) = 12	
(	(a) Power number		(b) F	low number		1 Stylian.	
(	(c) Shape factors		(d) F	roude numb	per.	Group - D	
(v) F	for laminar flow of	f filtrate thro	ugh the cake	deposited of	on sentum .	, is loved settling. Explain the operation of a	
f	ollowing will be val	lid?	agn the cure	ucpositeu (	i septuni, (	hig scentiate between free and hindered setting.	
(	(a) Kozeny- Carma	an equation	(b) E	Ergun equati	on	pulletator with a neat diagram.	
(c) Burke Plummer equation (d) None of these.				None of these	end us classifier is being used for the separation of quartz particles and		
						thydraulic classifier free settling conditions. The specific gravities are range fro	
			Group - B			glena are 2.65 and 7.5 respectively. The original inventor galena and a mixed	
						goods to 0.0025 cm. Three fractions - pure que two materials in the mix	
2.(a) I	Define mesh numb	er. What are	e the utilities	of screening	g? Name thi	$e^{e}$ d faction – are obtained. What are the observe of (2+4) + 6 =	
:	standard sets of sci	reens.		1		faction?	
(h) (	Calculate the volum	ne surface me	an diameter (	for the follow	ving particul	the wortex formation during agitati	
(0)	Size of screen	-704+352	-352+176	-176+88	-88+44	Par what are the different methods of preventing vortex retterns what are the different types	
	opening (µ)					operation. With respect to flow-patterns, the	
	Mass of particle	. 25	37.5	62.5	75	<sup>50</sup> impellers? Give examples of each open	
	( <u> </u>				(1+2-	3) the average (305 mm) is agitated by a 6 blade turbline imperior	
14 12 1					(Chorden -	A pilot plant vessel (expolds number is 10 <sup>4</sup> , blending unle of twoer input will	
3.(a) F	For transportation	of hot, lump	y materials w	hich type of	conveyor is	prefer is 15 s. The power required is 0.4 kw/m <sup>3</sup> of liquid. What p	
1	Explain the action of	of a screw con	nveyor with a	neat diagram	n.	(3+3) + 6	
						required to give same biending and the second	
(c)14	that are the adva	ntages of n	neumatic con	vevors over	mechanica	required to give same biomany and the second	
(c)W E:	/hat are the adva xplain the workin	ntages of pr	neumatic con of a dilute p	veyors over hase pressu	mechanica	conversion of the biolitarian of	
(c) W Ez di	/hat are the adva xplain the workin iagram.	ntages of pr g principle of	neumatic con of a dilute p	veyors over hase pressu	r mechanica Ire system	converte a	
(c) W Ez di	/hat are the adva xplain the workin iagram.	ntages of pr g principle o	neumatic con of a dilute p	veyors over hase pressu	mechanica tre system (1+5) +	conversion required to give same biending Group – E (244) <sup>2</sup> What are the driving forces of filtration?	
(c)W Ez di	/hat are the adva xplain the workin iagram.	ntages of pr g principle o	neumatic con of a dilute p	veyors over hase pressu	r mechanica tre system (1+5) +	converse vith a Group – E (2+4) <sup>1</sup> What are the driving forces of filtration?	
(c) W Ez di	/hat are the adva xplain the workin iagram.	ntages of pr g principle o	neumatic con of a dilute p Group – C	veyors over hase pressu	r mechanica ire system (1+5) 4	(2+4) What are the driving forces of filtration?	
(c) W Ex di	/hat are the adva xplain the workin iagram. A material is crusi	ntages of pr g principle o hed in a law	neumatic con of a dilute p Group – C crusher and	veyors over hase pressu	mechanica tre system (1+5) + e size of th	(2+4) What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake?	
(c) W Ez di 4.(a) 4	/hat are the adva xplain the workin iagram. A material is crus reduced from 5 cm	ntages of pr g principle of hed in a jaw 1 to 1 cm with	neumatic con of a dilute p Group – C v crusher and h energy cons	veyors over hase pressu the averag umption of	mechanica tre system (1+5) + e size of th 1.32×104 J/k	(2+4) <sup>1</sup> ) What are the driving forces of filtration? NWhat are the main objectives of filter aid and washing of filter cake? Partice What is the main difference between compressible and incompressible cakes? g. What is the main difference between compressible and incompressible cakes?	
(c) W Ez di 4.(a) <i>I</i>	/hat are the adva xplain the workin iagram. A material is crust reduced from 5 cm be the consumptio	ntages of pr g principle of hed in a jaw n to 1 cm with n of energy t	Group - C Group - C crusher and h energy cons to crush the st	veyors over hase pressu the averag umption of ame materia	mechanica tre system (1+5) 4 e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c	(2+4) <sup>1</sup> What are the driving forces of filtration? (2+4) <sup>1</sup> What are the main objectives of filter aid and washing of filter cake? Particle What is the main difference between compressible and incompressible cakes? g. What in to 25 <sup>1</sup> Discuss the principle and operation of a rotary drum vacuum filter with the h	
(c) W Ex di 4.(a) <i>A</i>	/hat are the adva xplain the workin iagram. A material is crus reduced from 5 cm be the consumptio assuming i) Ritting	ntages of pr g principle of hed in a jaw n to 1 cm with n of energy t yer's law ii) Ki	Group - C Group - C crusher and h energy cons to crush the s ick's law?	veyors over hase pressu the averag umption of ame materia	r mechanica tre system (1+5) 4 e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c	(2+4) (2+3) (2	
(c) W Ey di 4.(a) <i>A</i>	/hat are the adva xplain the workin iagram. A material is crush reduced from 5 cm be the consumptio assuming i) Ritting	ntages of pr g principle of hed in a jaw n to 1 cm with n of energy t ger's law ii) Ki	Group - C Group - C crusher and h energy cons to crush the s ick's law?	veyors over hase pressu the averag umption of ame materia	r mechanica tre system (1+5) 4 e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c	(2+4) <sup>2</sup> What are the driving forces of filtration? (2+4) <sup>2</sup> What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? Partic What is the main difference between compressible and incompressible cakes? What is the principle and operation of a rotary drum vacuum filter with the h <sup>a</sup> neat diagram. 2 + 3 + 2 + 5	
(c) W Ey di 4.(a) <i>A</i> (b)	/hat are the adva xplain the workin iagram. A material is crush reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw	ntages of pr g principle of hed in a jaw to 1 cm with n of energy t ter's law ii) Ki een open-cir	neumatic con of a dilute p Group – C crusher and h energy cons to crush the st ick's law? cuit and close	veyors over hase pressu the averag umption of ame materia	r mechanica tre system (1+5) + e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c inding oper	(2+4) What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? Particle What is the main difference between compressible and incompressible cakes? What is the principle and operation of a rotary drum vacuum filter with the h a neat diagram. 2 + 3 + 2 + 5 tion with the principle and a pressure drop equation over the incompressible	
(c) W Ey di 4.(a) <i>I</i> (b)	/hat are the adva xplain the workin iagram. A material is crus reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo	ntages of pr g principle of hed in a jaw h to 1 cm with n of energy t yer's law ii) Ki een open-cir ork index.	neumatic con of a dilute p Group – C v crusher and h energy cons to crush the st ick's law? cuit and close	veyors over hase pressu the averag umption of ame materia	e size of th 1.32×10 <sup>4</sup> J/k I from 7.5 c inding oper	(214) What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? Particle What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the principle and operation of a rotary drum vacuum filter with the h aneat diagram. 2 + 3 + 2 + 5 (4+2)? Berive the total pressure drop equation over the incompressible (4+2)? Berive the total pressure drop equation over the incompressible	
(c) W Ez di 4.(a) <i>I</i> (b)	/hat are the adva xplain the workin iagram. A material is crusi reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo	ntages of pr g principle of hed in a jaw n to 1 cm with n of energy t ger's law ii) Ki een open-cir ork index.	Group – C Group – C Crusher and thenergy cons to crush the si tick's law? cuit and close	veyors over hase pressu the averag umption of ame materia	mechanica (1+5) + (1+5) + e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c inding oper (3+3) +	required to give same orenary $(0, 0)$ conversion of a rotary drum vacuum filter with the h aneat diagram. $(2+4)^2$ What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? What is the main difference between compressible and incompressible cakes? Discuss the principle and operation of a rotary drum vacuum filter with the h aneat diagram. $(2+3)^2$ Derive the total pressure drop equation over the incompressible $(4+2)^2$ Derive the total pressure drop equation over the incompressible $(4+2)^2$ Cakes. (where A, μ, α, ΔP, Rm, c, t, V have their usual meaning)	
(c) W Ez di 4.(a) <i>A</i> (b) 5.(a)	Vhat are the adva xplain the workin iagram. A material is crush reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo	ntages of pr g principle of hed in a jaw n to 1 cm with n of energy t ger's law ii) Ki een open-cim ork index. 2000 mm di	Group - C Group - C crusher and h energy cons to crush the s ick's law? cuit and close iameter, 100	veyors over hase pressu the averag umption of ame materia ed-circuit gr mm steel b	r mechanica tre system (1+5) 4 e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c inding oper (3+3) 4 palls are bei	required to give same orenary (arcs)   converting Group - E   (2+4) What are the driving forces of filtration?   (2+4) What are the main objectives of filter aid and washing of filter cake?   (arcs) What is the main difference between compressible and incompressible cakes?   (arcs) Discuss the principle and operation of a rotary drum vacuum filter with the h   (arcs) Discuss the principle and operation of a rotary drum vacuum filter with the h   (areat diagram. $2 + 3 + 2 + 5$ (4+2) Derive the total pressure drop equation over the incompressible cakes.   (arcs) The following relation between $\alpha$ and $\Delta P$ for superlight CaCO3 has	
(c) W Ez di 4.(a) <i>A</i> (b) 5.(a)	Vhat are the adva xplain the workin iagram. A material is crush reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo In a ball mill of crushing. Presently	ntages of pr g principle of hed in a jaw to 1 cm with n of energy t ter's law ii) Ki een open-cirr ork index. 2000 mm di y the mill run	Group - C Group - C crusher and h energy cons to crush the st ick's law? cuit and close iameter, 100 ns at 15 rpm.	veyors over hase pressu the averag umption of ame materia ed-circuit gr mm steel to At what spo	r mechanica tre system (1+5) 4 e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c inding oper (3+3) 4 palls are bei eed will the	required to give same orenary $(0, 0)^{-1}$ (244) What are the driving forces of filtration? (244) What are the main objectives of filter aid and washing of filter cake? (244) What are the main objectives of filter aid and washing of filter cake? (244) What are the main objectives of filter aid and washing of filter cake? (244) What is the main difference between compressible and incompressible cakes? (244) What is the main difference between compressible and incompressible cakes? (244) What is the main difference between compressible and incompressible cakes? (245) Discuss the principle and operation of a rotary drum vacuum filter with the h <sup>a</sup> heat diagram. (442) <sup>a</sup> Derive the total pressure drop equation over the incompressible (442) <sup>a</sup> Derive the total pressure drop equation over the incompressible (442) <sup>a</sup> Derive the total pressure drop equation over the incompressible (442) <sup>b</sup> The following relation between α and ΔP for superlight CaCO <sub>3</sub> has mill har determined: (440) 0861 where ΔP is in kg/m <sup>2</sup> .	
(c) W E2 di 4.(a) <i>A</i> (b) 5.(a)	/hat are the adva xplain the workin iagram. A material is crush reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo In a ball mill of crushing. Presently run if 100 mm bal	ntages of pr g principle of hed in a jaw n to 1 cm with n of energy t ter's law ii) Ki een open-cirr ork index. 2000 mm di y the mill ruu ls are replace	neumatic con of a dilute p Group - C o crusher and h energy cons to crush the st ick's law? cuit and close iameter, 100 ns at 15 rpm. ed by 50 mm	veyors over hase pressu the averag umption of ame materia ed-circuit gr mm steel t At what spo balls, all oth	r mechanica ure system (1+5) 4 e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c inding oper (3+3) 4 palls are bei eed will the user condition	required to give same oremany $(0, 0)^{-1}$ with a <b>Group - E</b> (2+4) What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the principle and operation of a rotary drum vacuum filter with the h aneat diagram. 2 + 3 + 2 + 5 (4+2) <sup>2</sup> Derive the total pressure drop equation over the incompressible <b>Gakes.</b> (where A, μ, α, ΔP, R <sub>m</sub> , c, t, V have their usual meaning) Ing used the following relation between α and ΔP for superlight CaCO <sub>3</sub> has not be a first of the following relation between ΔP is in kg/m <sup>2</sup> .	
(c) W Ez di 4.(a) <i>A</i> (b) 5.(a)	/hat are the adva xplain the workin iagram. A material is crusi reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo In a ball mill of crushing. Presently run if 100 mm bal same?	ntages of pr g principle of hed in a jaw h to 1 cm with n of energy t yer's law ii) Ki een open-cir ork index. 2000 mm di y the mill run ls are replace	neumatic con of a dilute p Group – C o crusher and h energy cons to crush the st ick's law? cuit and close iameter, 100 ns at 15 rpm. ed by 50 mm	veyors over hase pressu the averag umption of ame materia ed-circuit gr mm steel to At what spo balls, all oth	r mechanica ure system (1+5) + e size of th 1.32×10 <sup>4</sup> J/k il from 7.5 c inding oper (3+3) + palls are bei eed will the ere condition	required to give same oremany (0.07) with a <b>Group - E</b> (2+4) What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the principle and operation of a rotary drum vacuum filter with the h aneat diagram. 2 + 3 + 2 + 5 (4+2) Derive the total pressure drop equation over the incompressible cakes.(where A, μ, α, ΔP, R <sub>m</sub> , c, t, V have their usual meaning) Ing used the following relation between α and ΔP for superlight CaCO <sub>3</sub> has there are a complete the total of the following relation between α and ΔP for superlight CaCO <sub>3</sub> has $\alpha = 7.8 \times 10^{10}[1+4.36 \times 10^{-4}(\Delta P)^{0.86}]$ , where ΔP is in kg/m <sup>2</sup> .	
(c) W Ey di 4.(a) <i>I</i> (b) 5.(a)	/hat are the adva xplain the workin iagram. A material is crusi reduced from 5 cm be the consumptio assuming i) Ritting Differentiate betw diagram. Define wo In a ball mill of crushing. Presently run if 100 mm bal same?	ntages of pr g principle of hed in a jaw to 1 cm with n of energy t ter's law ii) Ki een open-cir ork index. 2000 mm di y the mill ru Is are replace	neumatic con of a dilute p Group - C o crusher and h energy cons to crush the st ick's law? cuit and close iameter, 100 ns at 15 rpm. ed by 50 mm	veyors over hase pressu the averag umption of ame materia ed-circuit gr mm steel to At what spo balls, all oth	r mechanica ure system (1+5) + (1+	required to give same oremany $(0, 0, 0)$ with a <b>Group - E</b> (244) What are the driving forces of filtration? What are the main objectives of filter aid and washing of filter cake? Partice What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the main difference between compressible and incompressible cakes? What is the principle and operation of a rotary drum vacuum filter with the h aneat diagram. 2 + 3 + 2 + 5 (4+2) What is the total pressure drop equation over the incompressible Cakes.(where A, μ, α, ΔP, R <sub>m</sub> , c, t, V have their usual meaning) Multiplication where $\alpha$ and $\Delta P$ for superlight CaCO <sub>3</sub> has $\alpha = 7.8 \times 10^{10} [1+4.36 \times 10^{-4} (\Delta P)^{0.86}]$ , where $\Delta P$ is in kg/m <sup>2</sup> .	

**CHEN 2101** 

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### HE/Odd/Sem-31

## late the standa $_{2}H_{5}OH(1) + C$ of combustion H5OH H<sub>3</sub>COOH H5OOCCH3 on monoxide a

500° C in 90 ustion leave ed in the reac d assuming c O<sub>2</sub> and N<sub>2</sub> a ctively.)

oles of liquid through the tions the relation late the mole osition is 50 r

1.0g of neter, with a condensed, and the net l e latent heat o

# B.TECH/CHE/3rd SEM /CHEN 2101/2015

A slurry of this material giving 1.5 kg of cake solid/m<sup>3</sup> of filtrate is to be file a constant pressure drop of 50 kg/cm<sup>2</sup> and a temperature of 20°C. Experim this sludge and the filter cloth to be used gave a value of  $R_m = 1.2 \times 10^{10} \text{ m}^{-1}$ 

A plate and frame filter is to be used. Calculate the total no of frames requi give 2000 lit of filtrate in 1 hr. The viscosity of the water at 20°C is 1 cp and of one frame is 300 cm<sup>2</sup>.

## B.TECH/CHE/3rd SEM /CHEN 2102/2015 2015

### Fluid Mechanics (CHEN 2102)

Full Marks : 70

untted : 3 hrs

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and 6 + 6 any 5 (five) from Group B to E, taking at least one from each group. idates are required to give answer in their own words as far as practicable.

C 1) (	(Multiple Choice Type C hoose the correct alternatives for the followin the ratio of inertial forces to gravitational for a) Froude (b) Euler (c)	uestions) <sup>1g:</sup> ces is called Reynolds	10 x 1=10 - number (d) Mach.						
1)	The is measured by piezometric(a) Dynamic pressure(b) Stati(c) Total pressure(d) Poin	opening. c pressure t pressure							
	For an ideal fluid the Reynolds number is	) one	(d) 2100.						
	in innity for a circular cross-section pipe, the rat								
	of maximum to average fluid velocity is (a) 0.5 (b) 1	:) 0.66	(d) < 0.5.						
	The velocity profile for a Bingham plastic fluid flowing in laminar conditions in a								
	Pipe is (b) Parabolic (a) Flat (c) Flat near the wall and parabolic in the middle (d)Parabolic near the wall and flat in the middle.								
	The operation of a venturimeter is based of (a) Variable flow area (c) Pressure drop across a nozzle	n b) Pressure at a sta d) None of the abo	agnation point ove.						
The average velocity during pressure driven laminar flow through a r									
	(a) ½ maximum velocity (c) 1/3 maximum velocity	(b) 2/3 maximum (d) <sup>1</sup> / <sub>4</sub> maximum	n velocity velocity.						
	Contraction of the same water where the								

**CHEN 2101** 

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ITA

as

e