**CHEM-1.1.1**

**MODEL QUESTION PAPER**

**M.Tech (I Semester)**

**SUB:Process Modeling and Simulation**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from 2015-16 admitted batch)**

Time: 3 hrs Max. Marks: 70

 Question no.1 is Compulsory,

Answer four questions from remaining questions

1.Explain the following

 a) Modelling

 b) Controlled Variable

 c) Simulation

 d) Inflection point

 e) Explicit Method

 f) Jacobian Matrix

 g) Iterative Convergence

2 An irreversible exothermic reaction is carried out in a single perfectly mixed non-isothermal reactor. The reaction is A K B. The reaction is nth order and has a heat of reaction ‘λ’. Assuming negligible heat losses and constant densities. To remove heat of reaction, a cooling jacket surrounds the reactor. Cooling water is added to the jacket at volumetric flow rate of Fj with an inlet temperature of Tjo. The volume of the jacket Vj is constant. The mass of metal walls may be assumed negligible. Develop a mathematical model for the non-isothermal CSTR.

3.Explain Convergence procedure to find out the bubble point temperature of a binary vapour liquid mixture. State the assumptions made and explain the notation used clearly.

4.Solve the equation x3-3x2-x+9=0 for 5 iterations starting with x0= -2 using Newton- Raphson method

5.Develop a model for an energy equation in a CSTR where a consecutive reactions are occurring. State the assumptions completely.

6.Develop a mathematical model for Binary distillation column. State the assumptions completely.

7. Explain the following iterative convergence methods.

 a) R-K method b) False Position method

8.Write a Programme for solving Three CSTRs in series by Euler Method

 **CHEM-1.1.2**

**M.TECH FIRST SEMESTER**

 **Process Dynamics & Control**

**MODEL PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from 2015-16 admitted batch)**

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1. Write short notes on the following.
2. Routh stability criteria.
3. Cross over frequency.
4. Relative gain array.
5. Non Linear system.
6. Types of inversion of Z- transform.
7. Transition Matrix
8. Types of logs in distillation columns.
9. (a) A process [y(s) / x(s)] = 3s2 + 5s + 1, is subjected to (a) Step input,

(b) Impulse input and (c) ramp input. In each case, obtain the error

constant. X(t) can be considered as a set point. (6)

(b) What is a unit circle and its role in stability analysis. (8)

3. (a) Evaluate inverse Z- Transform of [2z2 + 3z]/ [(z+2)(z-4)] (8)

 (b) Obtain the Z –transform of x(s) = 1/ [s(s+1)] (6)

4. (a) Explain state space representation. (6)

 (b) Give a state space representation of a 4th order differential equation. (8)

5. (a) With reference to a simple pendulum, explain the concept of phase

plane trajectories. (8)

 (b) How does one analyze stability using phase plane techniques? (6)

6. (a) Explain the method of analysis of stability of multivariable systems. (8)

(b) Develop block diagrams for a two tank interactive system, considering

two inputs and two outputs. (6)

7. Write the general features of various composition control schemes used for

distillation column. (14)

8. With reference to a heat exchanger, discuss the interaction among the output

variables. How does one make a non- interacting control system? (14)

**CHEM 1.1.3**

M.Tech. Degree Examination

**Chemical Engineering**

First Semester

**CHEMICAL REACTION ENGINEERING**

**MODEL QUESTION PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from 2015-16 admitted batch)**

Time: 3 hours Max. Marks: 70

Answer question No. 1 and any FOUR questions

All questions carry equal marks.

1. Write very briefly about the following:

a) Law of mass action

b) Multiple reactions

c) Adiabatic isotherm

d) Catalyst reactivation

e) Damkohler number

f) Non-linear least squares

g) Catalyst properties

1. Calculate the activation energy for the decomposition of benzene diazonium chloride to give chloro-benzene and nitrogen using the following information for the first order reaction.

K(s-1) : 0.00043 0.00103 0.0018 0.00355 0.00717

T(K) : 313 319 323 328 333

1. A homogeneous liquid phase second order reaction A 🡪 R takes place with 50% conversion in a CSTR, if this CSTR is replaced by another CSTR having volume 2 times more than that of the earlier one. How much enhancement in conversion will be possible? If the original CSTR is replaced by a PFR of same size, how much enhancement in conversion will be possible? All other parameters remain same.
2. Discuss all possible ways available for maximizing the desired product in series reactions.
3. Discuss the design procedure for the design of adiabatic plug flow reactor.
4. The solid catalyzed gas phase reaction A🡪 2R is to be carried out in a fixed bed reactor at 5 bar and 400 K . The feed is an equimolar mixture of A and an inert gas. The feed rate to the reactor is 2.5 mol/hr. The rate equation is given as

 -rA = 0.09 pA/(1+0.015pA) kmol /kg cat.hr

Where pA is partial pressure A in bar, find the weight of the catalyst required for obtaining 80% conversion of A.

1. Derive the differential equation describing diffusion and reaction.
2. Explain the following:
3. Falsified kinetics
4. Chemical vopour deposition
5. Criteria used to evaluate laboratory reactors

**CHEM 1.1.4**

M.Tech. Degree Examination

**Chemical Engineering**

First Semester

**TRANSPORT PHENOMENA**

**MODEL QUESTION PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from 2015-16 admitted batch)**

Time: 3 hours Max. Marks: 70

Answer Five questions

Question No. 1 is compulsory

Answer any FOUR questions from the rest

All questions carry equal marks.

* 1. Briefly write about the following
1. Instantaneous velocity
2. Partial, total and substantial derivatives
3. Prandtl mixing length
4. Significance of different dimensionless numbers in mass transfer
5. Friction factor and drag coefficient
6. Thermal diffusivity
7. Nusselt number
	1. Derive equation of motion and reduce it to Euler’s equation.
	2. Obtain an expression for the velocity profile of tangential annular flow of a Newtonian liquid between two co-axial concentric cylinders in which the outer one is moving at an angular velocity Ω0 and the inner cylinder is stationary.
	3. Define friction factor. Derive expressions for friction factor for the cases of flow through circular conduit and flow around spheres.
	4. Consider two concentric porous spherical shells of inside radius KR and outside radius R. The inner surface of the outer one is at T = Ti, and the outer surface of the inner one is to be maintained at a lower temperature TK. Dry air at temperature T = TK is blown outward radially from the inner shell into the intervening space and out through the outer shell. Develop an expression for the required rate of heat removal from the inner sphere, as a function of the mass flow rate of gas. Assume steady, laminar flow and low gas velocity.

6. A slab occupying the space between y = -b and y = +b is initially at a temperature T0. At time t=0 the surface at y = ±b are suddenly raised to T1 and maintained there. Find the time dependent profile T(y,t).

7. a) Define different types of heat transfer coefficients conventionally used for the case of flow through circular conduits and flow around submerged objects and discuss their importance. b) Write short note on “Time smoothing of the energy equation”.

8. Show that the equation of continuity fot component ‘A’ in a binary mixture of ‘A’ and ‘B’ for constant density and diffusivity is obtained from first principle of mass conservation as:

 $\frac{∂C\_{A}}{∂t}+ \left(ϑ.∇C\_{A}\right)= D\_{AB} ∇^{2}C\_{A}+ RA$

**CHEM-1.1.5 A**

**M.Tech. Degree Examination**

**Chemical Engineering**

**First Semester**

**Model paper**

 **Elective-I: Petroleum Refinery Engineering – I**

 **(With effect from 2015-16 admitted batch)**

***Time: 3 hrs Marks: 70***

***Question No.1 is compulsory.***

***Answer any FOUR questions from the remaining.***

***All questions carry equal marks.***

1. Answer the following:
	1. Pretreatment of crude oil
	2. Cetane Number
	3. Characterization factor
	4. Electric Desalting
	5. Viscosity Index
	6. Smoke Point
	7. Vacuum distillation
2. Describe the classification of crude oil.
3. Discuss three stage distillation employed for crude oil with suitable flow sheet.
4. Describe catalytic cracking. With a neat flow sheet explain FCC.
5. Discuss the importance of Polymerization (in refinery operations). Describe Polymerization process with a neat flow sheet.
6. What are the necessary qualities of Asphalt? With a neat flow sheet describe sir blowing of bitumen..
7. Describe the importance of Reforming (in refinery operations). Describe reforming process along with flow sheet..
8. Write short notes on the following:
* Sulfur compounds in crude oil
* Gasoline Important tests
* Conradson Carbon
* Doctors sweetening process

**CHEM-1.1.5 B**

**M.Tech. Degree Examination**

**Chemical Engineering**

**First Semester**

**Model paper**

 **Elective-I: Process Dynamics and Control – I**

 **(Distillation Dynamics and Control)**

 **(With effect from 2015-16 admitted batch)**

Answer to Q.No.1 is compulsory. Answer any FOUR from the remaining questions. All questions carry equal marks.

Time: 3 hours Max. Marks: 70

1. Answer briefly to the following
2. Control objectives in distillation
3. Relative volatility
4. Fenske equation
5. Dead time
6. Internal reflux ratio
7. Controller pairing
8. vdW equation
9. Discuss strategies for control of xD or xB for upsets in xF.
10. Explain first order models for process identification
11. Write about limits of operability of plate columns
12. Discuss parallel cascade control
13. Enumerate various steps in obtaining a dynamic model
14. Describe the design of multicomponent distillation column using rigorous methods.
15. Write short notes on:
16. Raoult’s law
17. Azeotropes

**CHEM-1.1.5 C**

**M.Tech (Chemical Engineering) – Semester-I**

# Paper: Electro Chemical Engineering (Elective-I)

**(With effect from 2015-16 admitted batch)**

Time: 3hrs minutes Max Marks: 70

**(Model paper)**

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1. Explain the following briefly:
	1. Strong electrolytes
	2. Degree of dissociation
	3. Electrolysis
	4. Transport number
	5. Liquid junction potential
	6. Nernst equation
	7. Uniform corrosion
2. a) Explain in detail the Laws of Electrolysis. How would you determine the Faraday

 constant experimentally?

 b) In the Electrolysis of a solution containing cuprous copper, Nickel and Zinc complex ions

 a deposit of a metal weighing 0.175g was found to contain 72.8% Cu, 4.3%Ni and

 22.9%Zn. Assuming 100%efficiency for the electrolysis determine the number of

 Coulumbs which passed through the solution.

 (Atomic weights of Cu=63.54, Ni=58.71, Zn=65.37).

1. a) Define specific conductance, equivalent conductance and molar conductance.

 b) Calculate the time required to plate an area of 25cm2 with a deposit of copper of 0.1mm thick

 from a solution containing Cu2+ ions using a current of 0.50A? The density of copper is 8.9gm/cc

 and atomic weight of copper is 63.54.

**4. (**a)Sketch the copper coulometer and write down relevant electrochemical reactions in the coulometer bath.

 (b)Derive the Nernst equation and explain about its applications.

**5.** Explain about conductometric titrations

(i) Strong acid Vs strong base

(ii) Strong acid Vs weak base

6. What is polarisation and Explain in detail about active polarisation and concentration polarisation.

7. ( a) What is selective leaching? Explain

 (b) A metal bar having a total surface area of 10cm2.loses1.2mg when exposed to a particular environment for a month. Calculate the corrosion rate in mdd. The metal is bivalent in character while corroding and a Specific gravity of 7.8 and atomic weight of 55.85g/g-atom. Calculate current density in amperes/m2.

8. (a) discuss the effects of temperature and velocity on corrosion rates?

 (b) Explain about pitting corrosion and what is autocatalytic nature of pitting.

**CHEM-1.1.6 A**

**MODEL QUESTION PAPER**

**M.Tech Degree Examination**

**First semester**

**CHEMICAL ENGINEERING**

**ELECTIVE-II: CORROSION ENGINEERING - I**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Ionic conductance |
|  | (b) | Differential aeration cells |
|  | (c) | Intergranular corrosion |
|  | (d) | Calomel Reference half cell |
|  | (e) | Tafel equation |
|  | (f) | Flade potential |
|  | (g) | Pilling-Bed worth ratio |
|  |  |  |
| 2 | (a) | Differentiate between wet and dry corrosion. |
|  | (b) | State faraday’ laws.  |
|  | (c) | Calculate the time required to plate an area of 25 cm2 with a deposit of Copper of 0.1mm thick from a solution containing Cu2+ ions using a current of 0.50 A? The density of copper is 8.9 gm/cc and atomic weight of copper is 63.54. |
|  |  |  |
| 3 | (a) | What are the various regions of activity in Pourbaix diagram for Fe-H20 |
|  | (b) | With a neat diagram write a note on any two reference cells. |
|  |  |  |
| 4 | (a) | Write a note on Activation polarization. |
|  | (b) | For hydrogen evolution reaction the exchange current density is 6.8x10-7 A/cm. If the reaction is proceeding at an overpotential  V calculate the current density. Take the electrode area as 1 cm2 and  |
|  |  |  |
| 5 | (a) | Derive the Stern-Geary equation. |
|  | (b) | For iron (ρ = 7.8 gm/cm3) in a corrosive solution, the linear polarization slope at low current densities equals 2 mV/Acm2. Assuming βa = βc =0.1 V calculate the corrosion current in mpy. |
|  |  |  |
| 6 | (a) | What is passivity and how can the passivity of the metal can be achieved? |
|  | (b) | Write a note on Anodic Protection and Transpassivity. |
|  |  |  |
| 7 | (a) | Explain about the effects of dissolved oxygen and temperature on corrosion of iron in Water. |
|  | (b) | Write about the influence of gases in the atmosphere on corrosion of iron.  |
|  |  |  |
| 8 | (a) | Elaborate on remedial measures to be taken for reduction of corrosion rates of Iron in soils.  |
|  | (b) | Write notes on Protective and non-protective scales |
|  |  |  |

**CHEM-1.1.6 B**

**MODEL QUESTION PAPER**

**M.Tech Degree Examination**

**First semester**

**CHEMICAL ENGINEERING**

**ELECTIVE-II: ENERGY ENGINEERING - I**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and answer any FOUR from remaining questions.**

1. Write the following
 a) Solar energy as renewable energy
 b) Nuclear fusion
 c) Pyranometer
 d) Local Apparent time
 e) Concentration ratio
 f) Heliostat
 e)energy plantation
2. Explain the method of estimating the radiation on inclined surface.
3. What are flat plate collectors? Classify and mention the advantages and disadvantages of each type. Show and explain its various elements with suitable sketch.
4. Calculate the angle of incidence of beam radiation on flat plate collectors for the following situation:

 Location : Nagpur (21006’N,79003’E)

 Slop of collector : 310

 Date : Dec 1st , 1979

 Time : 09.00hr (IST)

1. What are the concentrating solar collectors, how are they classified? Explain parabolic through concentrator (PTC) with suitable diagram.
2. What is thermo chemical storage? Explain the criteria used for selection of mechanical reaction for solar application.
3. Explain in detail the operation problems associated with solar ponds.
4. (a) Write short notes on working of photovoltaic cell.
5. A solar cell is made from single crystal silicon and the array consists of 24 modules, each model consists of 36 cells with 10.4x 10.4 cm size. It is given that the inverter efficiency is 85 %. calculate power output in watts.

**CHEM- 1.2.1**

**Model question Paper**

**M.Tech Degree Examination**

**Chemical Engineering**

**Second Semester**

**COMPUTER AIDED DESIGN**

**(Common with Computer Aided Chemical Engineering and Industrial Pollution control Engineering)**

 **(Effective from the admitted batch of 2015-16)**

Answer question no. 1 and any other FOUR questions

All questions carry equal marks

Time : 3hrs Max. Marks: 70

1. Write short notes on the following

(a)Time dependent fluids

(b) Sequential modular approach

© Classification of condensers

(d) Extent of reaction

(e) Semibatch reactor

(f) Mean residence time

(g) Pressure drop calculations in two phase flow

1. (a) What is simulation? Explain the advantages of simulation

(b) Write the functions and features of an executive program

1. (a) What is a recycle process? How an executive program identifies recycle in the process?

(b) Write the procedure for sequence of calculation for recycle process with the help of an example

1. Give algorithm for pipeline network calculations
2. Write stepwise procedure for performance calculations in a packed bed absorber.
3. Write an algorithm for the calculation of circulation rate in vertical thermosiphon reboiler.
4. (a) What are the methods used to determine rate equation from the experimental data. Explain them in detail.

(b) Explain the ideal reactor models.

1. Give detailed procedure for simulation of binary distillation column using Mc Cabe Thiele method.

**CHEM-1.2.2**

**M.Tech. Degree Examination**

**Chemical Engineering**

**Second Semester**

 **ADVANCED ENGG MATHS AND STATISTICS**

**MODEL QUESTION PAPER**

 **(Effective from the admitted batch of 2015-16)**

Answer any five questions

All questions carry equal marks

Time : 3hrs Max. Marks: 70

1. Write down the finite-difference analogue of the equation  and solve it for the region bounded by the square  and  , the boundary conditions being  with
 h = k = 1.0, use Gauss-Seidel method to compute the values of u at the internal mesh

 points.

1. Use Crank-Nicholson formula to solve  subject to  at t=0 for  and u=0 at x=0 and x=0 for k>1. For h= 0.2, k= 0.04 and compute the values of u at the internal mesh points upto three time steps.
2. Solve with the conditions:  taking h=1/4, k=1/32 up to t=1/8.
3. Solve the equation  with the conditions y(0)=1 and y(0.1)=0. Compute y(0.2) and y(0.4).
4. Solve the boundary–value problem  by the shooting method.
5. Evaluate the following double integral  by using Simpson’s
(1/3)-rule.
6. The frequency distribution of a measurable characteristic varying between 0 and 2 is as under . Calculate the standard deviation and the mean deviation about the mean.
7. A Random variable X has the following probability function 
8. Find the value of K.
9. Evaluate P(0<X<5)
10. Evaluate P(X<6) and .

**CHEM-1.2.3**

**M.Tech. Degree Examination**

**Chemical Engineering**

**Second Semester**

 **ADVANCED MASS TRANSFER**

**MODEL QUESTION PAPER**

 **(Effective from the admitted batch of 2015-16)**

Answer Five questions

Question No. 1 is compulsory

Answer any FOUR questions from the rest

All questions carry equal marks.

1. Write very briefly about the following:

a) Fick’s second law and its application

b) Different Mass transfer coefficients

c) Raoult’s law and Henry’s law and their applications

d) Give the jD correlation for mass transfer in flow parallel to flat plate

e) Chilton – Colburn analogy

f) Capacity coefficients and their use

g) Marangony effect

1. Explain and derive the Mass transfer flux equation for molecular diffusion in gases for the case of (i) Equimolar counter diffusion and (ii) A is diffusing through stagnant non diffusing B.
2. a) Explain the diffusion through a varying cross sectional area and derive the equation for mass transfer flux.

b) A sphere of naphthalene having a radius of 2.00 mm is suspended in a large volume of still air at 318 K and 1.01325 x 105 Pa. The surface temperature of the naphthalene can be assumed to be at 318 K and its vapor pressure at that temperature is 0.555 mm Hg. The DAB of naphthalene in air at 318 K is 6.92 x 10-6 m2/s. Calculate the rate of evaporation of naphthalene from the surface.

 4) a) Explain briefly about the diffusivities in gases

b) Explain briefly about the diffusivities in liquids

5) Explain the diffusivities of electrolytes in liquids

b) Predict the diffusion coefficients of dilute electrolytes for the following cases:

i) For KCl at 25 0C, calculate .

ii) For KCl at 18.5 0C, calculate .

iii) For CaCl2 at 25 0C, calculate . Also predict Di of ion Ca+2 and of Cl-.

Data: λ+(K+) =73.5, λ-(Cl-) =76.3, λ+(Ca2+/2) = 59.5

 6) Explain (a) The two film theory and (b) The penetration theory.

 7) Explain the mass transfer in the laminar boundary layer when the fluid is in laminar flow over a

 flat plate.

8).Explain the following briefly.

1. Individual and overall mass transfer coefficients.
2. Reynolds analogy.

**CHEM-1.2.4**

**M.Tech. Degree Examination**

**Chemical Engineering**

**Second Semester**

 **POLLUTION CONTROL**

**MODEL QUESTION PAPER**

 **(Effective from the admitted batch of 2015-16)**

Time: 3 hours Max. Marks: 70

Answer question No. 1 and any FOUR questions

All questions carry equal marks.

1. Write very briefly about the following:

a) COD

b) Sloughing in trickling filters

c) Oxygen demanding wastes

d) Reverse osmosis

e) Anaerobic digestion

f) Incineration

g) Principle involved in cyclone separator

1. What is an ecosystem? Discuss about producers, consumers and decomposers that contribute the biotic structure of an ecosystem.
2. What are the health effects due to the presence of particulate matter in air? What are the various techniques available for removal of same? Explain with the help of neat sketch the functioning of an Bag filter.
3. How do you classify the water pollutants? Explain the Activated Sludge process.
4. Explain the Tertiary treatment methods of water pollution.
5. What are the harmful effects of SOx? Explain the different methods to reduce the concentration in the effluent gases.
6. Discuss the control methods of effluents from fertilizer plants.
7. Explain the control methods of alcohol and metal finishing industries.

**CHEM-1.2.5 A**

**MODEL QUESTION PAPER**

**½ M.TECH (CHEMICAL)IIND SEMESTER**

**SUB: ELECTIVE – II : PERTROLEUM REFINERY ENGINEERING.**

**(Effective from the admitted batch of 2015-16 onwards)**

**Time:3hrs 70 marks**

**Answer Question no.1 and any four from the remaining Questions.**

**All questions carry equal marks.**

1. Write briefly on:

(a). Pyrolysis

(b). Fractionation

©. Aromatic feed stocks

(d). Catalytic cracking

(e). C2 hydrocarbons

(f). Liquid feed stocks

(g). Fixed bed reactors

2. With a neat flow chart explain the production of Synthesis gas.

 3.Discuss the production of Polyethylene with a neat flow chart.

 4.Explain the production of Isopropanol with a neat flow chart.

 5.(a).What are the various petrochemical feed stocks?

 (b).Describe the various refining processes that produce feed stocks for

 Petrochemical industry.

 6. With a neat flow chart explain the production of Butadiene.

 7. Enlist various derivatives of Aromatics. Discuss the manufacture of any two

 important derivatives of aromatics.

 8. Discuss the advantage of super fractionation in separation of Ethyl Benzene-

 Styrene. In brief, enlist the design procedure for multi phase reactor for oxo

 synthesis.

**CHEM-1.2.5 B**

**MODEL QUESTION PAPER**

**½ M.TECH (CHEMICAL)IIND SEMESTER**

**SUB: ELECTIVE – II : PROCESS DYNAMICS AND CONTROL-II**

**(Effective from the admitted batch of 2015-16 onwards)**

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1. Explain the following.
2. PFTR.
3. Multiphase Models.
4. Eigen Values
5. Van Herden diagram
6. Liapunov functions
7. Lumped parameter model
8. (a) Explain mass and energy balance equations for CSTR.

(b) Explain the necessity of mathematical modeling for process control.

3. (a) Discuss the criteria for uniqueness of steady state for isothermal

and temperature dependent reactors.

 (b) Explain the effect of concentration on multiple steady states.

4. (a) Explain briefly the Krasovskill’s theorem and V- Functions in F- Space.

 (b) Explain the concept of “Globally stable systems”.

5. What is fundamental linearization theorem? Explain its applications in

 non- linear analysis with an example.

6. Explain “steady state multiplicity”. Will a PFTR exhibit “ steady state

Multiplicity”? Explain in detail.

7. (a) Explain briefly the Galerkin Methiod.

 (b) Obtain an analytical solution for the tubular reactor considering a

TRAM model.

8. Write short notes on:

 (a) Design considerations of CSTR

 (B) Uniqueness criterion for fixed bed reactor’s

**CHEM-1.2.5 C**

 **MODEL QUESTION PAPER**

**M.Tech Degree Examination**

**Second Semester**

**CHEMICAL ENGINEERING**

**ELECTIVE-II: ELECTROCHEMICAL ENGINEERING - II**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Throwing power |
|  | (b) | Electrolytic Cleaning |
|  | (c) | Electroplating |
|  | (d) | Diaphragm cells |
|  | (e) | Battery Capacity |
|  | (f) | Primary battery |
|  | (g) | Lithium ion battery |
|  |  |  |
| 2 |  | Draw a flow sheet for production of nickel using electrorefining process |
|  |  |  |
| 3 | (a) | Explain Electrowinning process.  |
|  | (b) | Draw a flow sheet for production of chromium using Electrowinning process |
|  |  |  |
| 4 |  | Explain the manufacturing processes for the following1. Hydrogen ii) cuprous oxide
 |
|  |  |  |
| 5 | (a) | Classify cells and batteries |
|  | (b) | Write a note on lithium batteries |
|  |  |  |
| 6 | (a) | Explain with the help of a neat diagram and reactions the functioning of lead acid batteries  |
|  | (b) | Write a note rechargeable alkaline batteries |
|  |  |  |
| 7 |  | With a neat sketch write a detailed note on molten carbonate fuel cell |
|  |  |  |
| 8 |  | Write notes on:  |
|  | (a) | Electrophoresis |
|  | (b) | Solid oxide fuel cell |

**CHEM-1.2.6 A**

**M.Tech (Chemical Engineering) – Semester-II**

# Paper: Corrosion Engineering (Elective-II)

***(Effective from the admitted batch of 2015-16)***

Time: 3hrs Max marks: 70

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1. Explain the following briefly:

 a. Fretting corrosion

 b. passivity

 c. Stress corrosion

 d. Nernst equation

 e. Hydrogen damage

 f. Inhibitors

 g. Decarburization

2. How the corrosion rates are calculated and write detailed notes on corrosion rate expressions?

3. (a) what is crevice and pitting corrosion? Write down its mechanism and prevention methods.

 (b) How do you anodically protect a steel storage tank containing a sulfuric acid?

4. (a)Explain about pitting corrosion and what is autocatalytic nature of pitting.

 (b)What is the main purpose of corrosion testing?

5. (a) Why evaluation of cleanliness of metal surfaces are required.

 (b) What is crevice corrosion? Write down its mechanism and prevention methods

6. Write about

 (a) Mechanical polishing

 (b) Electro polishing

 (c) Explain the concept of metallic cladding

7. What is meant by selective leaching and explain characteristics of dezincification and the mechanism involved.

8. (a) Explain about vapor deposition of metallic coatings.

 (b) Give brief account on phosphate coatings.

**CHEM-1.2.6 B**

**M.TECH(CHEMICAL) SECOND SEMESTER**

**(Model Paper)**

 **Elective-II: Energy Engineering – II**

**Non-conventional Energy Systems**

**(With effect from the admitted batch of 2015-16 onwards)**

Answer to Q.No.1 is compulsory. Answer any FOUR from the remaining questions. All questions carry equal marks.

Time: 3 hours Max. Marks: 70

1. Answer briefly to the following
2. Thermoelectricity
3. Classification of fuel cells
4. V – I characteristics of fuel cells
5. Dormancy
6. Magnus effect
7. Phonon
8. Velocity of ocean waves
9. Discuss in detail the method of anaerobic digestion to produce biogas from biomass.
10. With the help of neat diagrams explain several types of wind turbine configurations.
11. Explain wavegen system for obtaining ocean wave energy.
12. (a) Write about OTEC efficiency (b) Discuss the importance of siting in OTEC
13. Enumerate various features of Ceramic Fuel Cells.
14. How gaseous impurities such as hydrogen sulphide, carbon monoxide and carbon dioxide are removed from hydrogen gas?
15. Write short notes on:
16. Hydrogen storage
17. Salination energy

**MODEL QUESTION PAPER**

 **MPE-1.1.1**

**M.Tech (I Semester)Chemical,CACE,IPCE,MPE**

**SUB:Process Modeling and Simulation**

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3 hours Max. Marks: 70

 Question no.1 is Compulsory,

Answer Four questions from remaining questions

1.Explain the following

 a) Modelling

 b) Controlled Variable

 c) Simulation

 d) Inflection point

 e) Explicit Method

 f) Jacobian Matrix

 g) Iterative Convergence

2 An irreversible exothermic reaction is carried out in a single perfectly mixed non-isothermal reactor. The reaction is A K B. The reaction is nth order and has a heat of reaction ‘λ’. Assuming negligible heat losses and constant densities. To remove heat of reaction, a cooling jacket surrounds the reactor. Cooling water is added to the jacket at volumetric flow rate of Fj with an inlet temperature of Tjo. The volume of the jacket Vj is constant. The mass of metal walls may be assumed negligible. Develop a mathematical model for the non-isothermal CSTR. (14)

3.Explain Convergence procedure to find out the bubble point temperature of a binary vapour liquid mixture. State the assumptions made and explain the notation used clearly.

4.Solve the equation x3-3x2-x+9=0 for 5 iterations starting with x0= -2 using Newton- Raphson method

5.Develop a model for an energy equation in a CSTR where a consecutive reactions are occurring. State the assumptions completely

6.Develop a mathematical model for Binary distillation column. State the assumptions completely.

7. Explain the following iterative convergence methods.

 a) R-K method b) False Position method

8.Wtite a Programme for solving Three CSTRs in series by Euler Method

 **MPE-1.1.2**

**M.TECH FIRST SEMESTER**

 **Process Dynamics & Control**

**MODEL PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from the admitted batch of 2015-16 onwards)**

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1.Write short notes on the following.

1. Routh stability criteria.
2. Cross over frequency.
3. Relative gain array.
4. Non Linear system.
5. Types of inversion of Z- transform.
6. Transition Matrix
7. Types of logs in distillation columns.

2.(a) A process [y(s) / x(s)] = 3s2 + 5s + 1, is subjected to (a) Step input,

(b) Impulse input and (c) ramp input. In each case, obtain the error

constant. X(t) can be considered as a set point.

(b) What is a unit circle and its role in stability analysis.

3. (a) Evaluate inverse Z- Transform of [2z2 + 3z]/ [(z+2)(z-4)]

 (b) Obtain the Z –transform of x(s) = 1/ [s(s+1)]

4. (a) Explain state space representation.

 (b) Give a state space representation of a 4th order differential equation.

5. (a) With reference to a simple pendulum, explain the concept of phase

plane trajectories.

 (b) How does one analyze stability using phase plane techniques?

6. (a) Explain the method of analysis of stability of multivariable systems.

(b) Develop block diagrams for a two tank interactive system, considering

two inputs and two outputs.

7. Write the general features of various composition control schemes used for

distillation column.

8. With reference to a heat exchanger, discuss the interaction among the output

variables. How does one make a non- interacting control system?

**MPE 1.1.3**

M.Tech. Degree Examination

**Chemical Engineering**

First Semester

**CHEMICAL REACTION ENGINEERING**

**MODEL QUESTION PAPER**

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3 hours Max. Marks: 70

Answer question No. 1 and any FOUR questions

All questions carry equal marks.

1.Write very briefly about the following:

a) Law of mass action

b) Multiple reactions

c) Adiabatic isotherm

d) Catalyst reactivation

e) Damkohler number

f) Non-linear least squares

g) Catalyst properties

2.Calculate the activation energy for the decomposition of benzene diazonium chloride to give chloro-benzene and nitrogen using the following information for the first order reaction.

K(s-1) : 0.00043 0.00103 0.0018 0.00355 0.00717

T(K) : 313 319 323 328 333

3.A homogeneous liquid phase second order reaction A 🡪 R takes place with 50% conversion in a CSTR, if this CSTR is replaced by another CSTR having volume 2 times more than that of the earlier one. How much enhancement in conversion will be possible? If the original CSTR is replaced by a PFR of same size, how much enhancement in conversion will be possible? All other parameters remain same.

4.Discuss all possible ways available for maximizing the desired product in series reactions.

5.Discuss the design procedure for the design of adiabatic plug flow reactor.

6.The solid catalyzed gas phase reaction A🡪 2R is to be carried out in a fixed bed reactor at 5 bar and 400 K . The feed is an equimolar mixture of A and an inert gas. The feed rate to the reactor is 2.5 mol/hr. The rate equation is given as

 -rA = 0.09 pA/(1+0.015pA) kmol /kg cat.hr

Where pA is partial pressure A in bar, find the weight of the catalyst required for obtaining 80% conversion of A.

7.Derive the differential equation describing diffusion and reaction.

8.Explain the following:

a).Falsified kinetics b).Chemical vopour deposition

c).Criteria used to evaluate laboratory reactors

**MPE 1.1.4**

M.Tech. Degree Examination

**MINERAL PROCESS ENGINEERING**

First Semester

**TRANSPORT PHENOMENA**

**MODEL QUESTION PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from 2015-16 admitted batch)**

Time: 3 hours Max. Marks: 70

Answer Five questions

Question No. 1 is compulsory

Answer any FOUR questions from the rest

All questions carry equal marks.

1.Briefly write about the following

 (a)Instantaneous velocity

 (b)Partial, total and substantial derivatives

 (c)Prandtl mixing length

 (d)Significance of different dimensionless numbers in mass transfer

 (e)Friction factor and drag coefficient

 (f)Thermal diffusivity

 (g)Nusselt number

2.Derive equation of motion and reduce it to Euler’s equation.

3. Obtain an expression for the velocity profile of tangential annular flow of a Newtonian liquid between two co-axial concentric cylinders in which the outer one is moving at an angular velocity Ω0 and the inner cylinder is stationary.

4. Define friction factor. Derive expressions for friction factor for the cases of flow through circular conduit and flow around spheres.

1. Consider two concentric porous spherical shells of inside radius KR and outside radius R. The inner surface of the outer one is at T = Ti, and the outer surface of the inner one is to be maintained at a lower temperature TK. Dry air at temperature T = TK is blown outward radially from the inner shell into the intervening space and out through the outer shell. Develop an expression for the required rate of heat removal from the inner sphere, as a function of the mass flow rate of gas. Assume steady, laminar flow and low gas velocity.

6. A slab occupying the space between y = -b and y = +b is initially at a temperature T0. At time t=0 the surface at y = ±b are suddenly raised to T1 and maintained there. Find the time dependent profile T(y,t).

7. a) Define different types of heat transfer coefficients conventionally used for the case of flow through circular conduits and flow around submerged objects and discuss their importance.

 b) Write short note on “Time smoothing of the energy equation”.

8. Show that the equation of continuity fot component ‘A’ in a binary mixture of ‘A’ and ‘B’ for constant density and diffusivity is obtained from first principle of mass conservation as:

 $\frac{∂C\_{A}}{∂t}+ \left(ϑ.∇C\_{A}\right)= D\_{AB} ∇^{2}C\_{A}+ RA$

**MPE-1.1.5 A**

**Model Question Paper**

**M.Tech DEGREE EXAMINATION**

**Chemical Engineering**

**First Semester**

**Elective – GEOLOGY**

**(Effective from the admitted batch of 2015-16)**

Time: 3 hours Max. Marks: 70

Question No.1 is compulsory

Answer any **Four** from the remaining

All questions carry equal marks

1. Answer the following
2. Oceanic crust
3. Nebula
4. Incrustation
5. Axis of symmetry
6. Differentiate between texture and structure
7. True dip
8. Epoch
9. Write an essay on the interior of the earth with neat sketches?
10. a. What is symmetry? Discuss briefly about the symmetry elements of the crystals?

b. Discuss about the classification of Exogenetic mineral deposits?

1. a. Define sedimentary rock? How do you classify them into different categories, explain?

b. What are the characteristic features of sedimentary rocks?

1. Define folds? Discuss about their classification with neat diagrams?
2. a. Discuss briefly about the Geological Time Scale and add a note on its importance?
3. Write an essay on the classification of Cuddapah system of rocks?
4. Write short notes on any two of the following
5. Physical properties of minerals
6. Symmetry elements of Beryl type crystals with neat sketches
7. Unconformities

**MPE-1.1.5 B**

**M.Tech. Degree Examination**

**Chemical Engineering**

**First Semester**

**Model paper**

 **Elective-I: Petroleum Refinery Engineering – I**

**(With effect from the admitted batch of 2015-16 onwards)**

**Time: 3 hrs Marks: 70**

***Question No.1 is compulsory.***

***Answer any FOUR questions from the remaining.***

***All questions carry equal marks.***

1. Answer the following:
	1. Pretreatment of crude oil
	2. Cetane Number
	3. Characterization factor
	4. Electric Desalting
	5. Viscosity Index
	6. Smoke Point
	7. Vacuum distillation

2.Describe the classification of crude oil.

3.Discuss three stage distillation employed for crude oil with suitable flow sheet.

4.Describe catalytic cracking. With a neat flow sheet explain FCC.

5.Discuss the importance of Polymerization (in refinery operations). Describe Polymerization process with a neat flow sheet.

6.What are the necessary qualities of Asphalt? With a neat flow sheet describe sir blowing of bitumen..

7.Describe the importance of Reforming (in refinery operations). Describe reforming process along with flow sheet..

8.Write short notes on the following:

* Sulfur compounds in crude oil
* Gasoline Important tests
* Conradson Carbon
* Doctors sweetening process

**MPE-1.1.5 C**

**M.Tech (Chemical Engineering) – Semester-I**

# Paper: Electro Chemical Engineering (Elective-I)

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3hrs minutes Max Marks: 70

**(Model paper)**

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1.Explain the following briefly:

* 1. Strong electrolytes
	2. Degree of dissociation
	3. Electrolysis
	4. Transport number
	5. Liquid junction potential
	6. Nernst equation
	7. Uniform corrosion

2.a) Explain in detail the Laws of Electrolysis. How would you determine the Faraday

 constant experimentally?

 b) In the Electrolysis of a solution containing cuprous copper, Nickel and Zinc complex ions

 a deposit of a metal weighing 0.175g was found to contain 72.8% Cu, 4.3%Ni and

 22.9%Zn. Assuming 100%efficiency for the electrolysis determine the number of

 Coulumbs which passed through the solution.

 (Atomic weights of Cu=63.54, Ni=58.71, Zn=65.37).

3.a) Define specific conductance, equivalent conductance and molar conductance.

 b) Calculate the time required to plate an area of 25cm2 with a deposit of copper of 0.1mm thick

 from a solution containing Cu2+ ions using a current of 0.50A? The density of copper is 8.9gm/cc

 and atomic weight of copper is 63.54.

**4. (**a)Sketch the copper coulometer and write down relevant electrochemical reactions in the coulometer bath.

 (b)Derive the Nernst equation and explain about its applications.

**5.** Explain about conductometric titrations

(i) Strong acid Vs strong base

(ii) Strong acid Vs weak base

6. What is polarisation and Explain in detail about active polarisation and concentration polarisation. 7

7. ( a) What is selective leaching? Explain

 (b) A metal bar having a total surface area of 10cm2.loses1.2mg when exposed to a particular environment for a month. Calculate the corrosion rate in mdd. The metal is bivalent in character while corroding and a Specific gravity of 7.8 and atomic weight of 55.85g/g-atom. Calculate current density in amperes/m2.

8. (a) discuss the effects of temperature and velocity on corrosion rates?

 (b) Explain about pitting corrosion and what is autocatalytic nature of pitting.

**MPE-1.1.6 A**

**MODEL QUESTION PAPER**

**M.Tech Degree Examination**

First semester

**CHEMICAL ENGINEERING**

**ELECTIVE-II: CORROSION ENGINEERING - I**

*(Effective from the admitted batch of 2015-16)*

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Ionic conductance |
|  | (b) | Differential aeration cells |
|  | (c) | Intergranular corrosion |
|  | (d) | Calomel Reference half cell |
|  | (e) | Tafel equation |
|  | (f) | Flade potential |
|  | (g) | Pilling-Bed worth ratio |
|  |  |  |
| 2 | (a) | Differentiate between wet and dry corrosion. |
|  | (b) | State faraday’ laws.  |
|  | (c) | Calculate the time required to plate an area of 25 cm2 with a deposit of Copper of 0.1mm thick from a solution containing Cu2+ ions using a current of 0.50 A? The density of copper is 8.9 gm/cc and atomic weight of copper is 63.54. |
|  |  |  |
| 3 | (a) | What are the various regions of activity in Pourbaix diagram for Fe-H20 |
|  | (b) | With a neat diagram write a note on any two reference cells. |
|  |  |  |
| 4 | (a) | Write a note on Activation polarization. |
|  | (b) | For hydrogen evolution reaction the exchange current density is 6.8x10-7 A/cm. If the reaction is proceeding at an overpotential  V calculate the current density. Take the electrode area as 1 cm2 and  |
|  |  |  |
| 5 | (a) | Derive the Stern-Geary equation. |
|  | (b) | For iron (ρ = 7.8 gm/cm3) in a corrosive solution, the linear polarization slope at low current densities equals 2 mV/Acm2. Assuming βa = βc =0.1 V calculate the corrosion current in mpy. |
|  |  |  |
| 6 | (a) | What is passivity and how can the passivity of the metal can be achieved? |
|  | (b) | Write a note on Anodic Protection and Transpassivity. |
|  |  |  |
| 7 | (a) | Explain about the effects of dissolved oxygen and temperature on corrosion of iron in Water. |
|  | (b) | Write about the influence of gases in the atmosphere on corrosion of iron.  |
|  |  |  |
| 8 | (a) | Elaborate on remedial measures to be taken for reduction of corrosion rates of Iron in soils.  |
|  | (b) | Write notes on Protective and non-protective scales |
|  |  | **MPE-1.1.6 B****MODEL QUESTION PAPER****M.Tech Degree Examination**First semester**CHEMICAL ENGINEERING****ELECTIVE-II: ENERGY ENGINEERING - I***(Effective from the admitted batch of 2015-16)*Time: 3 hours Max. Marks: 70**Question no. ONE is compulsory and****answer any FOUR from remaining questions.** |

1. Write the following
 a) Solar energy as renewable energy
 b) Nuclear fusion
 c) Pyranometer
 d) Local Apparent time
 e) Concentration ratio
 f) Heliostat
 e)energy plantation
2. Explain the method of estimating the radiation on inclined surface.
3. What are flat plate collectors? Classify and mention the advantages and disadvantages of each type. Show and explain its various elements with suitable sketch.
4. Calculate the angle of incidence of beam radiation on flat plate collectors for the following situation:

 Location : Nagpur (21006’N,79003’E)

 Slop of collector : 310

 Date : Dec 1st , 1979

 Time : 09.00hr (IST)

1. What are the concentrating solar collectors, how are they classified? Explain parabolic through concentrator (PTC) with suitable diagram.
2. What is thermo chemical storage? Explain the criteria used for selection of mechanical reaction for solar application.
3. Explain in detail the operation problems associated with solar ponds.
4. (a) Write short notes on working of photovoltaic cell.

(b).A solar cell is made from single crystal silicon and the array consists of 24 modules, each model consists of 36 cells with 10.4x 10.4 cm size. It is given that the inverter efficiency is 85 %. calculate power output in watts.

**MPE-1.2.1**

**Model Question Paper**

**M.Tech (MPE) (II Semester)**

**Mineral Process Engineering -I**

**(With effect from the admitted batch of 2015-16 onwards)**

 Time: 3 hours Marks: 70

 Question no.1 is Compulsory,

Answer Four questions from remaining questions

 1. a. What do you understand by terms ore and minerals.

 b. What is comminution? Briefly explain principle methods of comminution.

 c. Differentiate between open and closed circuit grinding
 d. What is meant by reduction ratio?

 e. State Kick’s law and Rittingers’s law

 f. What is free and hinderedered settling?

 g. Explain critical speed and optimum speed of a ball mill.

2. What are ore and its constituents? Explain the principle steps involved in the separation of the desired mineral particle from the ore.

3. How are size reduction equipment classified. Describe briefly the working of one equipment in each category

4. How do you graphically represent the data obtained from size analysis? Explain how particles are sized by sedimentation?

5. A material is crushed in a jaw crusher and the average size of the particle is reduced from 50mm to 10mm with the consumption of energy at the rate of 13.0KW/tone. What will be the consumption of energy to crush the same material from an oversize of 75mm to 25mm assuming a) Rittingers’s law b) Kick’s law

6. What are the Classic laws of crushing and grinding? Explain the working of conical ball mill with a neat sketch?

7. Describe how the area of a thickener can be calculated from batch sedimentation data?

8. What are the methods of separation depending upon the difference in physical properties?
 Explain the principle involved in the centrifugal separation?

**MPE-1.2.2**

**Model Question Paper**

**M.Tech (MPE) (II Semester)**

**Mineral Process Engineering II**

**(With effect from the admitted batch of 2015-16 onwards)**

 Time: 3 hours Marks: 70

 Question no.1 is Compulsory,

Answer Four questions from remaining questions

1.Explain the following

 a) Contact angle

 b) Classification

 c) Vortex Finder

 d) Clarification

 e) Settling

 f) Terminal Velocity

 g) Vacuum Filtration

2. a)Explain the mechanism and working principle of Dense Media Separation

b) Explain the operation of Dense Media Separation with a neat diagram

 3. a) What is Jigging Explain the factors affecting the stratification in Jigging

b) Explain the process of Jigging with a neat flow sheet

4 a) Explain the theory and working principle of Tabling

b) Describe the process of separation in a Shaking Table with a neat sketch

5 a) What is Sedimentation Explain the theory and working principle of Thickening

 b)Explain the operation of Vacuum Filtration with a neat diagram

6.Explain various Filtration reagents and describe one industrial application of Filtration

7. a) Explain Cyclone Separation

b)Explain Air Cyclone Separator with a neat sketch

8. Explain completely the cleaning of Coal starting from Crushing etc with a neat sketch

**MPE-1.2.3**

**MODEL PAPER**

**M.Tech. (II Semester)**

**Mineral Processing Engineering (MPE)**

 **Processing of Ores**

**(Effective from the admitted batch of 2015-16 onwards)**

Time:3 hrs Marks:70

**Instructions:** I. Answer 5 questions of the following

 II. Q.no.1 is compulsory

1. Write short notes on the following

 a) Autogenous grinding

 b) Xenothermal Deposites

 c) Dense media separation

 d) List out Rare Earth Minerals

 e) Role of Modifiers in Flotation

 f) Amalgamation

 g) Cobbing of Mica

2. Explain the Beneficiation process of Manganese ore with a neat process diagram

3. List out the uses of Bauxite and explain in detail the process of extracting Alumina from ore

4. What is differential flotation and explain the scheme of enrichment of Zinc& Lead to its required

 grades with neat sketch

5. Write the purpose and problems associated with Coal washers in India

6. Describe the origin, occurrence and geographical distribution of copper deposits in India and explain its

 beneficiation process

7. Draw a detailed process flow sheet for separation of heavy minerals from Chavara beach sands and

 explain the process steps

8. a) Describe the function of washing pan used in the beneficiation of Diamond deposits

 b) Explain the occurrence, geographical distribution and uses of Limestone

**MPE-1.2.4**

**Model Question paper**

M.TECH DEGREE EXAMINATION

Mineral Process Engineering

Second Semester

 **COAL PREPARATION**

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3 Hrs Max marks: 70

***Question No.1 is compulsory.***

***Answer any FOUR questions from the remaining.***

***All questions carry equal marks.***

1.Write short notes on the following:

* 1. Origin and formation of coal
	2. Coal Sampling
	3. Washability characteristics
	4. Screening
	5. Thickeners
	6. Coking of coal
	7. Crushing ratio

2.Explain in general about coal classification.

3.(a)What is grindability of coal?

 (b)Discuss in detail about storage of coal industry.

4.Explain in detail about high temperature carbonization.

5.Compare and contrast dry process and wet process for coal washing.

6.Discuss the salient points in transportation of coal from pit head to the point of utilization.

7.Explain the significance of coal constituents based on proximate and ultimate analysis.

8.Discuss the occurrence of lignite deposits and their distribution and mention the important properties and industrial uses of lignite.

**MPE-1.2.5 A**

**Model Question paper**

**M.TECH DEGREE EXAMINATION**

**Mineral Process Engineering**

**Second Semester**

**Sub: Elective-I: Analytical Techniques in Mineral Engineering**

**Common with: MINERAL PROCESS ENGINEERING AND INDUSTRIAL POLLUTION ENGINEERING**

**(With effect from the admitted batch of 2015-16 onwards)**

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1. Explain the following.
2. Caking index.
3. Stages in chemical analysis.
4. Gravimetry.
5. Colorimetry.
6. Beer-Lambert’s Law.
7. Electrolysis.
8. Analysis of ash.
9. Explain in detail about the stages of mineral sampling and sample stability.

3. Discuss the wet assaying of ores of iron, copper, lead, zinc in detail.

4. Give the operating and working principles of ultraviolet and infrared

Spectrophotometer. Explain, how the analysis of a given mineral is carried out

 using a spectrophotometer.

5. Explain clearly about the Flame Emission spectrophotometry with neat sketch.

6. (a) Give the principle of X- ray diffraction technique.

 (b) Discuss, how the mineral is characterized using Debye- Scherrer

camera with suitable examples.

7. Explain the principle and operation of Adsorption chromatography. What are its applications? Discuss.

8. Draw a labeled circuit diagram of a recording polagraph. Why is the dropping

 mercury electrode is used in polarographic analysis?

**MPE-1.2.5 B**

**MODEL QUESTION PAPER**

**½ M.TECH (CHEMICAL)IIND SEMESTER**

**SUB: ELECTIVE – II : PERTROLEUM REFINERY ENGINEERING.**

**(Effective from the admitted batch of 2015-16 onwards)**

**Time:3hrs 70 marks**

**Answer Question no.1 and any four from the remaining Questions.**

**All questions carry equal marks.**

1.Write briefly on:

(a). Pyrolysis

(b). Fractionation

©. Aromatic feed stocks

(d). Catalytic cracking

(e). C2 hydrocarbons

(f). Liquid feed stocks

(g). Fixed bed reactors

2. With a neat flow chart explain the production of Synthesis gas.

 3.Discuss the production of Polyethylene with a neat flow chart.

 4.Explain the production of Isopropanol with a neat flow chart.

 5.(a).What are the various petrochemical feed stocks?

 (b).Describe the various refining processes that produce feed stocks for

 Petrochemical industry.

 6. With a neat flow chart explain the production of Butadiene.

 7. Enlist various derivatives of Aromatics. Discuss the manufacture of any two

 important derivatives of aromatics.

 8. Discuss the advantage of super fractionation in separation of Ethyl Benzene-

 Styrene. In brief, enlist the design procedure for multi phase reactor for oxo

 synthesis.

**MPE-1.2.5 C**

 **MODEL QUESTION PAPER**

**M.Tech Degree Examination**

**Second Semester**

**CHEMICAL ENGINEERING**

**ELECTIVE-II: ELECTROCHEMICAL ENGINEERING - II**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Throwing power |
|  | (b) | Electrolytic Cleaning |
|  | (c) | Electroplating |
|  | (d) | Diaphragm cells |
|  | (e) | Battery Capacity |
|  | (f) | Primary battery |
|  | (g) | Lithium ion battery |
|  |  |  |
| 2 |  | Draw a flow sheet for production of nickel using electrorefining process |
|  |  |  |
| 3 | (a) | Explain Electrowinning process.  |
|  | (b) | Draw a flow sheet for production of chromium using Electrowinning process |
|  |  |  |
| 4 |  | Explain the manufacturing processes for the following1. Hydrogen ii) cuprous oxide
 |
|  |  |  |
| 5 | (a) | Classify cells and batteries |
|  | (b) | Write a note on lithium batteries |
|  |  |  |
| 6 | (a) | Explain with the help of a neat diagram and reactions the functioning of lead acid batteries  |
|  | (b) | Write a note rechargeable alkaline batteries |
|  |  |  |
| 7 |  | With a neat sketch write a detailed note on molten carbonate fuel cell |
|  |  |  |
| 8 |  | Write notes on:  |
|  | (a) | Electrophoresis |
|  | (b) | Solid oxide fuel cell |

**MPE-1.2.6 A**

**M.Tech (Chemical Engineering) – Semester-II**

# Paper: Corrosion Engineering (Elective-II)

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3hrs Max marks: 70

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1.Explain the following briefly:

 a. Fretting corrosion

 b. passivity

 c. Stress corrosion

 d. Nernst equation

 e. Hydrogen damage

 f. Inhibitors

 g. Decarburization

2. How the corrosion rates are calculated and write detailed notes on corrosion rate expressions?

3. (a) what is crevice and pitting corrosion? Write down its mechanism and prevention methods.

 (b) How do you anodically protect a steel storage tank containing a sulfuric acid?

4. (a)Explain about pitting corrosion and what is autocatalytic nature of pitting.

 (b)What is the main purpose of corrosion testing?

5. (a) Why evaluation of cleanliness of metal surfaces are required.

 (b) What is crevice corrosion? Write down its mechanism and prevention methods

6. Write about

 (a) Mechanical polishing

 (b) Electro polishing

 (c) Explain the concept of metallic cladding

7. What is meant by selective leaching and explain characteristics of dezincification and the mechanism involved.

8. (a) Explain about vapor deposition of metallic coatings.

 (b) Give brief account on phosphate coatings.

**MPE-1.2.6 B**

**M.TECH(CHEMICAL) SECOND SEMESTER**

**(Model Paper)**

 **Elective-II: Energy Engineering – II**

**(With effect from the admitted batch of 2015-16 onwards)**

**Non-conventional Energy Systems**

Answer to Q.No.1 is compulsory. Answer any FOUR from the remaining questions. All questions carry equal marks.

Time: 3 hours Max. Marks: 70

1.Answer briefly to the following

1. Thermoelectricity
2. Classification of fuel cells
3. V – I characteristics of fuel cells
4. Dormancy
5. Magnus effect
6. Phonon
7. Velocity of ocean waves

2.Discuss in detail the method of anaerobic digestion to produce biogas from biomass.

3.With the help of neat diagrams explain several types of wind turbine configurations.

4.Explain wavegen system for obtaining ocean wave energy.

5.(a) Write about OTEC efficiency (b) Discuss the importance of siting in OTEC

6.Enumerate various features of Ceramic Fuel Cells.

7.How gaseous impurities such as hydrogen sulphide, carbon monoxide and carbon dioxide are removed from hydrogen gas?

8.Write short notes on:

A. Hydrogen storage

1. Salination energy

 **IPCE-1.1.1**

**M.Tech (I Semester)Chemical,CACE,IPCE,MPE**

**SUB:Process Modeling and Simulation**

**MODEL QUESTION PAPER**

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3 hours Max. Marks: 70

 Question no.1 is Compulsory,

Answer Four questions from remaining questions

1.Explain the following

 a) Modelling

 b) Controlled Variable

 c) Simulation

 d) Inflection point

 e) Explicit Method

 f) Jacobian Matrix

 g) Iterative Convergence

2 An irreversible exothermic reaction is carried out in a single perfectly mixed non-isothermal reactor. The reaction is A K B. The reaction is nth order and has a heat of reaction ‘λ’. Assuming negligible heat losses and constant densities. To remove heat of reaction, a cooling jacket surrounds the reactor. Cooling water is added to the jacket at volumetric flow rate of Fj with an inlet temperature of Tjo. The volume of the jacket Vj is constant. The mass of metal walls may be assumed negligible. Develop a mathematical model for the non-isothermal CSTR. (14)

3.Explain Convergence procedure to find out the bubble point temperature of a binary vapour liquid mixture. State the assumptions made and explain the notation used clearly.

4.Solve the equation x3-3x2-x+9=0 for 5 iterations starting with x0= -2 using Newton- Raphson method

5.Develop a model for an energy equation in a CSTR where a consecutive reactions are occurring. State the assumptions completely

6.Develop a mathematical model for Binary distillation column. State the assumptions completely.

7. Explain the following iterative convergence methods.

 a) R-K method b) False Position method

8.Wtite a Programme for solving Three CSTRs in series by Euler Method

 **IPCE-1.1.2**

**M.TECH FIRST SEMESTER**

 **Process Dynamics & Control**

**MODEL PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from the admitted batch of 2015-16 onwards)**

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1.Write short notes on the following.

a).Routh stability criteria.

b).Cross over frequency.

c).relative gain array.

d).Non Linear system.

e).Types of inversion of Z- transform.

f).Transition Matrix

g).Types of logs in distillation columns.

2.(a) A process [y(s) / x(s)] = 3s2 + 5s + 1, is subjected to (a) Step input,

(b) Impulse input and (c) ramp input. In each case, obtain the error

constant. X(t) can be considered as a set point.

(b) What is a unit circle and its role in stability analysis.

3. (a) Evaluate inverse Z- Transform of [2z2 + 3z]/ [(z+2)(z-4)]

 (b) Obtain the Z –transform of x(s) = 1/ [s(s+1)]

4. (a) Explain state space representation.

 (b) Give a state space representation of a 4th order differential equation.

5. (a) With reference to a simple pendulum, explain the concept of phase

plane trajectories.

 (b) How does one analyze stability using phase plane techniques?

6. (a) Explain the method of analysis of stability of multivariable systems.

(b) Develop block diagrams for a two tank interactive system, considering

two inputs and two outputs.

7. Write the general features of various composition control schemes used for

distillation column.

8. With reference to a heat exchanger, discuss the interaction among the output

variables. How does one make a non- interacting control system?

**IPCE 1.1.3**

M.Tech. Degree Examination

**Chemical Engineering**

First Semester

**CHEMICAL REACTION ENGINEERING**

**MODEL QUESTION PAPER**

**(With effect from the admitted batch of 2015-16 onwards)**

Time: 3 hours Max. Marks: 70

Answer question No. 1 and any FOUR questions

All questions carry equal marks.

1.Write very briefly about the following:

a) Law of mass action

b) Multiple reactions

c) Adiabatic isotherm

d) Catalyst reactivation

e) Damkohler number

f) Non-linear least squares

g) Catalyst properties

2.Calculate the activation energy for the decomposition of benzene diazonium chloride to give chloro-benzene and nitrogen using the following information for the first order reaction.

K(s-1) : 0.00043 0.00103 0.0018 0.00355 0.00717

T(K) : 313 319 323 328 333

3.A homogeneous liquid phase second order reaction A 🡪 R takes place with 50% conversion in a CSTR, if this CSTR is replaced by another CSTR having volume 2 times more than that of the earlier one. How much enhancement in conversion will be possible? If the original CSTR is replaced by a PFR of same size, how much enhancement in conversion will be possible? All other parameters remain same. (14)

4.Discuss all possible ways available for maximizing the desired product in series reactions.

5.Discuss the design procedure for the design of adiabatic plug flow reactor.

6.The solid catalyzed gas phase reaction A🡪 2R is to be carried out in a fixed bed reactor at 5 bar and 400 K . The feed is an equimolar mixture of A and an inert gas. The feed rate to the reactor is 2.5 mol/hr. The rate equation is given as

 -rA = 0.09 pA/(1+0.015pA) kmol /kg cat.hr

Where pA is partial pressure A in bar, find the weight of the catalyst required for obtaining 80% conversion of A.

7.Derive the differential equation describing diffusion and reaction.

8.Explain the following:

a).Falsified kinetics

b).Chemical vopour deposition

c).Criteria used to evaluate laboratory reactors

**IPCE 1.1.4**

M.Tech. Degree Examination

**INDUSTRIAL POLLUTION CONTROL ENGINEERING**

First Semester

**TRANSPORT PHENOMENA**

**MODEL QUESTION PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**(With effect from 2015-16 admitted batch)**

Time: 3 hours Max. Marks: 70

Answer Five questions

Question No. 1 is compulsory

Answer any FOUR questions from the rest

All questions carry equal marks.

1. Briefly write about the following

(a).Instantaneous velocity

(b).Partial, total and substantial derivatives

©. Prandtl mixing length

(d).Significance of different dimensionless numbers in mass transfer

(e).Friction factor and drag coefficient

(f).Thermal diffusivity

(g).Nusselt number

1. Derive equation of motion and reduce it to Euler’s equation.
2. Obtain an expression for the velocity profile of tangential annular flow of a Newtonian liquid between two co-axial concentric cylinders in which the outer one is moving at an angular velocity Ω0 and the inner cylinder is stationary.
3. Define friction factor. Derive expressions for friction factor for the cases of flow through circular conduit and flow around spheres.
4. Consider two concentric porous spherical shells of inside radius KR and outside radius R. The inner surface of the outer one is at T = Ti, and the outer surface of the inner one is to be maintained at a lower temperature TK. Dry air at temperature T = TK is blown outward radially from the inner shell into the intervening space and out through the outer shell. Develop an expression for the required rate of heat removal from the inner sphere, as a function of the mass flow rate of gas. Assume steady, laminar flow and low gas velocity.

 6. A slab occupying the space between y = -b and y = +b is initially at a temperature T0. At time t=0 the surface at y = ±b are suddenly raised to T1 and maintained there. Find the time dependent profile T(y,t).

7. a) Define different types of heat transfer coefficients conventionally used for the case of flow through circular conduits and flow around submerged objects and discuss their importance.

 b) Write short note on “Time smoothing of the energy equation”.

8. Show that the equation of continuity fot component ‘A’ in a binary mixture of ‘A’ and ‘B’ for constant density and diffusivity is obtained from first principle of mass conservation as:

 $\frac{∂C\_{A}}{∂t}+ \left(ϑ.∇C\_{A}\right)= D\_{AB} ∇^{2}C\_{A}+ RA$

**IPCE-1.1.5 A**

**MODEL PAPER**

**M.Tech. IPCE (I Semester)**

**Industrial Pollution Control Engineering (IPCE)**

 **Management and Control of Industrial Wastewater and Solids**

**Effective from the admitted batch of 2015-16 onwards**

**Time:3 hrs Marks:70**

**Instructions:** I. Answer 5 questions of the following

 II. Q.no.1 is compulsory

1. Write short notes on the following

 a) TOC

 b) BOD curve

 c) Trickling filters

 d) Mass Volume Index

 e) Oxidation ponds

 f) Ozonation

 g) Biogas negation

2. What are the sources of industrial water pollutants? Discuss the estimation of BOD and COD of Industrial waste waters

3. Explain in detail activated sludge process for treatment of Industrial Effluents with a neat schematic diagram

4. Explain in detail the following secondary treatment methods for industrial waste waters

 a) Attached growth process

 b) Biological contractors

5. Describe various advance treatment methods and also explain the methods of removal Nitrogen and Phosphate compounds

6. Differentiate between aerobic and anaerobic digestion of sludge treatment and explain in detail the process steps involved

7. What are the critical characterstics of solid waste and explain the method of proximate and ultimate analysis for ensuring energy content

8. Explain in detail the methods of transportation and sanitary landfill of solid waste

**IPCE-1.1.5 B**

**M.Tech. Degree Examination**

**Chemical Engineering**

**First Semester**

**Model paper**

 **Elective-I: Petroleum Refinery Engineering – I**

**Time: 3 hrs Marks: 70**

***Question No.1 is compulsory.***

***Answer any FOUR questions from the remaining.***

***All questions carry equal marks.***

1.Answer the following:

* 1. Pretreatment of crude oil
	2. Cetane Number
	3. Characterization factor
	4. Electric Desalting
	5. Viscosity Index
	6. Smoke Point
	7. Vacuum distillation

2.Describe the classification of crude oil.

3.Discuss three stage distillation employed for crude oil with suitable flow sheet.

4.Describe catalytic cracking. With a neat flow sheet explain FCC.

5.Discuss the importance of Polymerization (in refinery operations). Describe Polymerization process with a neat flow sheet.

6.What are the necessary qualities of Asphalt? With a neat flow sheet describe sir blowing of bitumen..

7.Describe the importance of Reforming (in refinery operations). Describe reforming process along with flow sheet..

8.Write short notes on the following:

* Sulfur compounds in crude oil
* Gasoline Important tests
* Conradson Carbon
* Doctors sweetening process

**IPCE-1.1.5 C**

**M.Tech (Chemical Engineering) – Semester-I**

# Paper: Electro Chemical Engineering (Elective-I)

**(With effect from the admitted batch of 2015-16 onwards)**

**(Model paper)**

Time: 3hrs minutes Marks: 70

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1.Explain the following briefly:

* 1. Strong electrolytes
	2. Degree of dissociation
	3. Electrolysis
	4. Transport number
	5. Liquid junction potential
	6. Nernst equation
	7. Uniform corrosion

2.a) Explain in detail the Laws of Electrolysis. How would you determine the Faraday

 constant experimentally?

 b) In the Electrolysis of a solution containing cuprous copper, Nickel and Zinc complex ions

 a deposit of a metal weighing 0.175g was found to contain 72.8% Cu, 4.3%Ni and

 22.9%Zn. Assuming 100%efficiency for the electrolysis determine the number of

 Coulumbs which passed through the solution.

 (Atomic weights of Cu=63.54, Ni=58.71, Zn=65.37).

3.a) Define specific conductance, equivalent conductance and molar conductance.

 b) Calculate the time required to plate an area of 25cm2 with a deposit of copper of 0.1mm thick

 from a solution containing Cu2+ ions using a current of 0.50A? The density of copper is 8.9gm/cc

 and atomic weight of copper is 63.54.

**4. (**a)Sketch the copper coulometer and write down relevant electrochemical reactions in the coulometer bath.

 (b)Derive the Nernst equation and explain about its applications.

**5.** Explain about conductometric titrations

(i) Strong acid Vs strong base

(ii) Strong acid Vs weak base

6. What is polarisation and Explain in detail about active polarisation and concentration polarisation.

7. ( a) What is selective leaching? Explain

 (b) A metal bar having a total surface area of 10cm2.loses1.2mg when exposed to a particular environment for a month. Calculate the corrosion rate in mdd. The metal is bivalent in character while corroding and a Specific gravity of 7.8 and atomic weight of 55.85g/g-atom. Calculate current density in amperes/m2.

7. (a) discuss the effects of temperature and velocity on corrosion rates?

 (b) Explain about pitting corrosion and what is autocatalytic nature of pitting.

8.How do you calculate Transport number using by using various methods.

**IPCE-1.1.6 A**

 **MODEL QUESTION PAPER**

**M.Tech Degree Examination**

First semester

**CHEMICAL ENGINEERING**

**ELECTIVE-II: CORROSION ENGINEERING - I**

*(Effective from the admitted batch of 2015-16)*

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Ionic conductance |
|  | (b) | Differential aeration cells |
|  | (c) | Intergranular corrosion |
|  | (d) | Calomel Reference half cell |
|  | (e) | Tafel equation |
|  | (f) | Flade potential |
|  | (g) | Pilling-Bed worth ratio |
|  |  |  |
| 2 | (a) | Differentiate between wet and dry corrosion. |
|  | (b) | State faraday’ laws.  |
|  | (c) | Calculate the time required to plate an area of 25 cm2 with a deposit of Copper of 0.1mm thick from a solution containing Cu2+ ions using a current of 0.50 A? The density of copper is 8.9 gm/cc and atomic weight of copper is 63.54. |
|  |  |  |
| 3 | (a) | What are the various regions of activity in Pourbaix diagram for Fe-H20 |
|  | (b) | With a neat diagram write a note on any two reference cells. |
|  |  |  |
| 4 | (a) | Write a note on Activation polarization. |
|  | (b) | For hydrogen evolution reaction the exchange current density is 6.8x10-7 A/cm. If the reaction is proceeding at an overpotential  V calculate the current density. Take the electrode area as 1 cm2 and  |
|  |  |  |
| 5 | (a) | Derive the Stern-Geary equation. |
|  | (b) | For iron (ρ = 7.8 gm/cm3) in a corrosive solution, the linear polarization slope at low current densities equals 2 mV/Acm2. Assuming βa = βc =0.1 V calculate the corrosion current in mpy. |
|  |  |  |
| 6 | (a) | What is passivity and how can the passivity of the metal can be achieved? |
|  | (b) | Write a note on Anodic Protection and Transpassivity. |
|  |  |  |
| 7 | (a) | Explain about the effects of dissolved oxygen and temperature on corrosion of iron in Water. |
|  | (b) | Write about the influence of gases in the atmosphere on corrosion of iron.  |
|  |  |  |
| 8 | (a) | Elaborate on remedial measures to be taken for reduction of corrosion rates of Iron in soils.  |
|  | (b) | Write notes on Protective and non-protective scales |
|  |  |  |

|  |  |  |
| --- | --- | --- |
|  |  | **IPCE-1.1.6 B****MODEL QUESTION PAPER****M.Tech Degree Examination**First semester**INDUSTRIAL POLLUTION CONTROL ENGINEERING****ELECTIVE-II: ENERGY ENGINEERING - I***(Effective from the admitted batch of 2015-16)*Time: 3 hours Max. Marks: 70**Question no. ONE is compulsory and****answer any FOUR from remaining questions.** |

1. Write the following
 a) Solar energy as renewable energy
 b) Nuclear fusion
 c) Pyranometer
 d) Local Apparent time
 e) Concentration ratio
 f) Heliostat
 e)energy plantation
2. Explain the method of estimating the radiation on inclined surface.
3. What are flat plate collectors? Classify and mention the advantages and disadvantages of each type. Show and explain its various elements with suitable sketch.
4. Calculate the angle of incidence of beam radiation on flat plate collectors for the following situation:

 Location : Nagpur (21006’N,79003’E)

 Slop of collector : 310

 Date : Dec 1st , 1979

 Time : 09.00hr (IST)

1. What are the concentrating solar collectors, how are they classified? Explain parabolic through concentrator (PTC) with suitable diagram.
2. What is thermo chemical storage? Explain the criteria used for selection of mechanical reaction for solar application.
3. Explain in detail the operation problems associated with solar ponds.
4. (a) Write short notes on working of photovoltaic cell.

(b).A solar cell is made from single crystal silicon and the array consists of 24 modules, each model consists of 36 cells with 10.4x 10.4 cm size. It is given that the inverter efficiency is 85 %. calculate power output in watts.

**IPCE- 1.2.1**

**Model question Paper**

**M.Tech Degree Examination**

**Chemical Engineering**

**Second Semester**

**COMPUTER AIDED DESIGN**

**(Common with Computer Aided Chemical Engineering and Industrial Pollution control Engineering)**

 **(Effective from the admitted batch of 2015-16)**

Answer question no. 1 and any other FOUR questions

All questions carry equal marks

Time : 3hrs Max. Marks: 70

1.Write short notes on the following

(a)Time dependent fluids

(b) Sequential modular approach

© Classification of condensers

(d) Extent of reaction

(e) Semibatch reactor

(f) Mean residence time

(g) Pressure drop calculations in two phase flow

2.(a) What is simulation? Explain the advantages of simulation

(b) Write the functions and features of an executive program

3.(a) What is a recycle process? How an executive program identifies recycle in the process?

(b) Write the procedure for sequence of calculation for recycle process with the help of an example

4.Give algorithm for pipeline network calculations

5.Write stepwise procedure for performance calculations in a packed bed absorber.

6.Write an algorithm for the calculation of circulation rate in vertical thermosiphon reboiler.

7.(a) What are the methods used to determine rate equation from the experimental data. Explain them in detail.

(b) Explain the ideal reactor models.

8.Give detailed procedure for simulation of binary distillation column using Mc Cabe Thiele method

 **IPCE- 1.2.2**

**Model question Paper**

M.Tech IPCE Second Semester

Industrial pollution control Engineering

**Air Pollution and Control in Industry**

(Effective from the admitted batch of 2015-16)

Answer question no. 1 and any other FOUR questions

All questions carry equal marks

Time : 3hrs Max. Marks: 70

1.Write short notes on the following

1. Inversion
2. Bag filter
3. Gaseous pollutants
4. Problems of air pollution
5. Berylliosis
6. Scrubbers
7. Effective stack height

2.Explain the principle of settling chamber and describe the design of the settling chamber.

3.How SO2 is removed from gaseous effluents from sulphuric acid plant. Explain the SO2 scrubbing system

 4.Sulphur dioxide is emitted through a stack 50m high and 2 m diameter at the exit

 temperature of 1200C with a velocity of 10m/s. The sulphur dioxide emission rate is 200g/s.

 Show how the ground level concentration at a down wind distance of 1Km varies with wind

 speed for stability category D when the pressure is 1 atm and ambient temperature is 250C.

 (Assume A=0.13, B=0.105 and p=0.827)

 5.Explain in detail the function of a parallel plate electrostatic precipitator with the help of a

 schematic diagram and discuss various design considerations for effective efficiency.

 6.Explain in detail the procedure for stack gas sampling and analysis for suspended

 particulate matter and gaseous pollutants SO2, NOx and CO

 7.Explain how you can control air pollutant emissions at source by raw material changes,

 process changes and equipment modifications or replacement and cite some of the major

 pollutant industries where you can employ the above methods

 8.A multi tray settling chamber having 8 trays, including the bottom surface, handles 6m3/s

 of air at 200C. The trays are spaced 0.25m part and chamber is to be 1 m wide and 4 m

 long. What is the minimum particle size of density 2000Kg/m3 that can be collected with

 100% efficiency. What will be the efficiency of the settling chamber if 50μm particles are

 to be removed. Laminar flow conditions in the chamber and no dust initially on trays may

 be assumed.

 **IPCE- 1.2.3**

**Model question Paper**

M.Tech IPCE Second Semester

**Analytical Techniques**

(Effective from the admitted batch of 2015-16)

**Common with: MINERAL PROCESS ENGINEERING AND INDUSTRIAL POLLUTION ENGINEERING**

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1.Explain the following.

a.Caking index.

b.Stages in chemical analysis.

c.Gravimetry.

d.Colorimetry.

e.Beer-Lambert’s Law.

f.Electrolysis.

g.Analysis of ash.

2. Explain in detail about the stages of mineral sampling and sample stability

3. Discuss the wet assaying of ores of iron, copper, lead, zinc in detail.

4. Give the operating and working principles of ultraviolet and infrared

Spectrophotometer. Explain, how the analysis of a given mineral is carried out

 using a spectrophotometer.

5. Explain clearly about the Flame Emission spectrophotometry with neat sketch.

6. (a) Give the principle of X- ray diffraction technique.

 (b) Discuss, how the mineral is characterized using Debye- Scherrer

camera with suitable examples.

7. Explain the principle and operation of Adsorption chromatography. What are its applications? Discuss.

8. Draw a labeled circuit diagram of a recording polagraph. Why is the dropping

 mercury electrode is used in polarographic analysis?

 **IPCE- 1.2.4**

**Model question Paper**

**M.Tech IPCE Second Semester**

**Environmental Biotechnoogy**

**(Effective from the admitted batch of 2015-16)**

**Common with: BIOTECHNOLOGY AND INDUSTRIAL POLLUTION ENGINEERING**

**Time: 3hrs Marks:70**

Answer any 5 of the following 1 one is compulsory all questions carry equal marks

1. Write short note on :

a. Ecosystem

1. Sludge
2. Acid rain
3. Biotransformation
4. Energy crops
5. Bioleaching
6. Hot spots of biodiversity
7. Write on sources, effects and control of air pollutants?
8. Describe advanced solid waste management techniques?
9. Explain role of genetic engineering in bioremediation?
10. Write short notes on
	1. Phytoremediation ?
	2. Global warming?
	3. Bio ethanol?
11. Write on renewable sources of energy with suitable examples?
12. Explain the role of microorganisms in bioabsorption of metals and discuss the limitations?
13. Write short notes on:
	1. Biopolymers?
	2. Biosensors?
	3. Conservation of biodiversity?

**IPCE-1.2.5 A**

**MODEL PAPER**

**M.Tech. IPCE (II Semester)**

**Industrial Pollution Control Engineering (IPCE)**

**IPCE-205: Industrial Hazards, Safety Measures and Environmental Impact Assessment**

**Effective from the admitted batch of 2015-16 onwards**

**Time: 3 hrs Marks: 70**

**Instructions:** I. Answer 5 questions of the following

 II. Q.no.1 is compulsory

1. Write short notes on the following

 a) Chemical Hazards

 b) Work permits

 c) Ergonamics

 d) Severity rate

 e) PPEs

 f) Static electricity

 g) Vapor Cloud Explosionn(VCE)

2. Explain in detail the methodology of conducting HAZOP study and prepare HAZOP work sheets for a Methanator

3. Explain in detail the following

 a) Fault Tree Analysis (FTA)

 b) Event Tree Analysis (ETA)

4. What is safety Audit and describe in detail its salient components

5. What is EIA and describe various steps involved in conducting EIA

6. Explain the following

 a) NFPA codes

 b) OSHA regulations for Noise limits

7. Describe various components of ISO 14001 EMS and its benefits

8. Explain various occupational hazards associated with and mitigation measures in

 a) Steel plants

 b) Electroplating industry

**IPCE-1.2.5 B**

**MODEL QUESTION PAPER**

**½ M.TECH (IPCE)IIND SEMESTER**

**SUB: ELECTIVE – II : PERTROLEUM REFINERY ENGINEERING.**

**(Effective from the admitted batch of 2015-16 onwards)**

**Time:3hrs 70 marks**

**Answer Question no.1 and any four from the remaining Questions.**

**All questions carry equal marks.**

1.Write briefly on:

(a). Pyrolysis

(b). Fractionation

©. Aromatic feed stocks

(d). Catalytic cracking

(e). C2 hydrocarbons

(f). Liquid feed stocks

(g). Fixed bed reactors

2. With a neat flow chart explain the production of Synthesis gas.

 3.Discuss the production of Polyethylene with a neat flow chart.

 4.Explain the production of Isopropanol with a neat flow chart.

 5.(a).What are the various petrochemical feed stocks?

 (b).Describe the various refining processes that produce feed stocks for

 Petrochemical industry.

 6. With a neat flow chart explain the production of Butadiene.

 7. Enlist various derivatives of Aromatics. Discuss the manufacture of any two

 important derivatives of aromatics.

 8. Discuss the advantage of super fractionation in separation of Ethyl Benzene-

 Styrene. In brief, enlist the design procedure for multi phase reactor for oxo

 synthesis.

**IPCE-1.2.5 C**

 **MODEL QUESTION PAPER**

**M.Tech (IPCE)Degree Examination**

**Second Semester**

**ELECTIVE-II: ELECTROCHEMICAL ENGINEERING - II**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Throwing power |
|  | (b) | Electrolytic Cleaning |
|  | (c) | Electroplating |
|  | (d) | Diaphragm cells |
|  | (e) | Battery Capacity |
|  | (f) | Primary battery |
|  | (g) | Lithium ion battery |
|  |  |  |
| 2 |  | Draw a flow sheet for production of nickel using electrorefining process |
|  |  |  |
| 3 | (a) | Explain Electrowinning process.  |
|  | (b) | Draw a flow sheet for production of chromium using Electrowinning process |
|  |  |  |
| 4 |  | Explain the manufacturing processes for the following1. Hydrogen ii) cuprous oxide
 |
|  |  |  |
| 5 | (a) | Classify cells and batteries |
|  | (b) | Write a note on lithium batteries |
|  |  |  |
| 6 | (a) | Explain with the help of a neat diagram and reactions the functioning of lead acid batteries  |
|  | (b) | Write a note rechargeable alkaline batteries |
|  |  |  |
| 7 |  | With a neat sketch write a detailed note on molten carbonate fuel cell |
|  |  |  |
| 8 |  | Write notes on:  |
|  | (a) | Electrophoresis |
|  | (b) | Solid oxide fuel cell |

**IPCE-1.2.6 A**

**M.Tech (IPCE) – Semester-II**

# Paper: Corrosion Engineering (Elective-II)

***(Effective from the admitted batch of 2015-16)***

**Model paper**

Time: 3hrs Max marks: 70

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1.Explain the following briefly:

 a. Fretting corrosion

 b. passivity

 c. Stress corrosion

 d. Nernst equation

 e. Hydrogen damage

 f. Inhibitors

 g. Decarburization

2. How the corrosion rates are calculated and write detailed notes on corrosion rate expressions?

3. (a) what is crevice and pitting corrosion? Write down its mechanism and prevention methods.

 (b) How do you anodically protect a steel storage tank containing a sulfuric acid?

4. (a)Explain about pitting corrosion and what is autocatalytic nature of pitting.

 (b)What is the main purpose of corrosion testing?

5. (a) Why evaluation of cleanliness of metal surfaces are required.

 (b) What is crevice corrosion? Write down its mechanism and prevention methods

6. Write about

 (a) Mechanical polishing

 (b) Electro polishing

 (c) Explain the concept of metallic cladding

7. What is meant by selective leaching and explain characteristics of dezincification and the mechanism involved.

8. (a) Explain about vapor deposition of metallic coatings.

 (b) Give brief account on phosphate coatings.

**IPCE-1.2.6 B**

**M.TECH(IPCE) SECOND SEMESTER**

**(Model Paper)**

 **Elective-II: Energy Engineering – II**

**(With effect from the admitted batch of 2015-16 onwards)**

**Non-conventional Energy Systems**

Answer to Q.No.1 is compulsory. Answer any FOUR from the remaining questions. All questions carry equal marks.

Time: 3 hours Max. Marks: 70

1.Answer briefly to the following

(a)Thermoelectricity

(b)Classification of fuel cells

©V – I characteristics of fuel cells

(d)Dormancy

(e)Magnus effect

(f)Phonon

(g)Velocity of ocean waves

2.Discuss in detail the method of anaerobic digestion to produce biogas from biomass.

3.With the help of neat diagrams explain several types of wind turbine configurations.

4.Explain wavegen system for obtaining ocean wave energy.

5(a) Write about OTEC efficiency (b) Discuss the importance of siting in OTEC

6.Enumerate various features of Ceramic Fuel Cells.

7.How gaseous impurities such as hydrogen sulphide, carbon monoxide and carbon dioxide are removed from hydrogen gas?

8.Write short notes on:

a.Hydrogen storage

b.Salination energy

 **CACE-1.1.1**

**M.Tech (I Semester)Chemical,CACE,IPCE,MPE**

**SUB:Process Modeling and Simulation**

***(Effective from the admitted batch of 2015-16)***

**MODEL QUESTION PAPER**

Time: 3 hours Max. Marks: 70

 Question no.1 is Compulsory,

Answer Four questions from remaining questions

1.Explain the following

 a) Modelling

 b) Controlled Variable

 c) Simulation

 d) Inflection point

 e) Explicit Method

 f) Jacobian Matrix

 g) Iterative Convergence

2 An irreversible exothermic reaction is carried out in a single perfectly mixed non-isothermal reactor. The reaction is A K B. The reaction is nth order and has a heat of reaction ‘λ’. Assuming negligible heat losses and constant densities. To remove heat of reaction, a cooling jacket surrounds the reactor. Cooling water is added to the jacket at volumetric flow rate of Fj with an inlet temperature of Tjo. The volume of the jacket Vj is constant. The mass of metal walls may be assumed negligible. Develop a mathematical model for the non-isothermal CSTR.

3.Explain Convergence procedure to find out the bubble point temperature of a binary vapour liquid mixture. State the assumptions made and explain the notation used clearly.

4.Solve the equation x3-3x2-x+9=0 for 5 iterations starting with x0= -2 using Newton- Raphson method

5.Develop a model for an energy equation in a CSTR where a consecutive reactions are occurring. State the assumptions completely

6.Develop a mathematical model for Binary distillation column. State the assumptions completely.

7. Explain the following iterative convergence methods.

 a) R-K method b) False Position method

8.Wtite a Programme for solving Three CSTRs in series by Euler Method

 **CACE-1.1.2**

**M.TECH FIRST SEMESTER**

 **Process Dynamics & Control**

**MODEL PAPER**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

***(Effective from the admitted batch of 2015-16)***

**Time: 3 hours Max. Marks: 70**

Answer question No. 1 (Compulsory) and

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1.Write short notes on the following.

(a)Routh stability criteria.

(b)Cross over frequency.

©Relative gain array.

(d)Non Linear system.

(e)Types of inversion of Z- transform.

(f)Transition Matrix

(g).Types of logs in distillation columns.

2.(a) A process [y(s) / x(s)] = 3s2 + 5s + 1, is subjected to (a) Step input,

(b) Impulse input and (c) ramp input. In each case, obtain the error

constant. X(t) can be considered as a set point.

(b) What is a unit circle and its role in stability analysis.

3. (a) Evaluate inverse Z- Transform of [2z2 + 3z]/ [(z+2)(z-4)]

 (b) Obtain the Z –transform of x(s) = 1/ [s(s+1)]

4. (a) Explain state space representation.

 (b) Give a state space representation of a 4th order differential equation.

5. (a) With reference to a simple pendulum, explain the concept of phase

plane trajectories.

 (b) How does one analyze stability using phase plane techniques?

6. (a) Explain the method of analysis of stability of multivariable systems.

(b) Develop block diagrams for a two tank interactive system, considering

two inputs and two outputs.

7. Write the general features of various composition control schemes used for

distillation column.

8. With reference to a heat exchanger, discuss the interaction among the output

variables. How does one make a non- interacting control system?

**CACE 1.1.3**

M.Tech. Degree Examination

**Chemical Engineering**

First Semester

**CHEMICAL REACTION ENGINEERING**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**MODEL QUESTION PAPER**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

Answer question No. 1 and any FOUR questions

All questions carry equal marks.

1.Write very briefly about the following:

a) Law of mass action

b) Multiple reactions

c) Adiabatic isotherm

d) Catalyst reactivation

e) Damkohler number

f) Non-linear least squares

g) Catalyst properties

2.Calculate the activation energy for the decomposition of benzene diazonium chloride to give chloro-benzene and nitrogen using the following information for the first order reaction.

K(s-1) : 0.00043 0.00103 0.0018 0.00355 0.00717

T(K) : 313 319 323 328 333

3.A homogeneous liquid phase second order reaction A 🡪 R takes place with 50% conversion in a CSTR, if this CSTR is replaced by another CSTR having volume 2 times more than that of the earlier one. How much enhancement in conversion will be possible? If the original CSTR is replaced by a PFR of same size, how much enhancement in conversion will be possible? All other parameters remain same.

4.Discuss all possible ways available for maximizing the desired product in series reactions.

5.Discuss the design procedure for the design of adiabatic plug flow reactor.

6.The solid catalyzed gas phase reaction A🡪 2R is to be carried out in a fixed bed reactor at 5 bar and 400 K . The feed is an equimolar mixture of A and an inert gas. The feed rate to the reactor is 2.5 mol/hr. The rate equation is given as

 -rA = 0.09 pA/(1+0.015pA) kmol /kg cat.hr

Where pA is partial pressure A in bar, find the weight of the catalyst required for obtaining 80% conversion of A.

7.Derive the differential equation describing diffusion and reaction.

8.Explain the following:

a.Falsified kinetics

b.Chemical vopour deposition

c.Criteria used to evaluate laboratory reactors

**CACE 1.1.4**

M.Tech. Degree Examination

**Computer aided Chemical Engineering**

First Semester

**Transport phenomena**

**(Common for Chem. Engg, Mineral Process Engg, Computer aided Chem..Engg. & Ind.Pollu.Control Engg. )**

**MODEL QUESTION PAPER**

***(Effective from the admitted batch of 2015-16)***

Time: 3 hours Max. Marks: 70

Answer question No. 1 and any FOUR questions

All questions carry equal marks.

1. Briefly write about the following

(a)Instantaneous velocity

(b)Partial, total and substantial derivatives

©Prandtl mixing length

(d)Significance of different dimensionless numbers in mass transfer

(e)Friction factor and drag coefficient

(f)Thermal diffusivity

(g)Nusselt number

1. Derive equation of motion and reduce it to Euler’s equation.
2. Obtain an expression for the velocity profile of tangential annular flow of a Newtonian liquid between two co-axial concentric cylinders in which the outer one is moving at an angular velocity Ω0 and the inner cylinder is stationary.
3. Define friction factor. Derive expressions for friction factor for the cases of flow through circular conduit and flow around spheres.
4. Consider two concentric porous spherical shells of inside radius KR and outside radius R. The inner surface of the outer one is at T = Ti, and the outer surface of the inner one is to be maintained at a lower temperature TK. Dry air at temperature T = TK is blown outward radially from the inner shell into the intervening space and out through the outer shell. Develop an expression for the required rate of heat removal from the inner sphere, as a function of the mass flow rate of gas. Assume steady, laminar flow and low gas velocity.

6. A slab occupying the space between y = -b and y = +b is initially at a temperature T0. At time t=0 the surface at y = ±b are suddenly raised to T1 and maintained there. Find the time dependent profile T(y,t).

7. a) Define different types of heat transfer coefficients conventionally used for the case of flow through circular conduits and flow around submerged objects and discuss their importance.

 b) Write short note on “Time smoothing of the energy equation”.

8. Show that the equation of continuity fot component ‘A’ in a binary mixture of ‘A’ and ‘B’ for constant density and diffusivity is obtained from first principle of mass conservation as:

 $\frac{∂C\_{A}}{∂t}+ \left(ϑ.∇C\_{A}\right)= D\_{AB} ∇^{2}C\_{A}+ RA$

**CACE-1.1.5 A**

**Model Question Paper**

 M.Tech First semester (Computer Aided Chemical Engineering)

**ELECTIVE-I: Computational Fluid Flow and Heat Transfer**

Time: Three Hours Maximum: 70 Marks

Question ONE is Compulsory

Answer any other FOUR Questions

All Questions carry equal Marks

1. Explain the following

(a). Crank- Nicolson method

(b). Implicit finite difference method

(c). Write a short note on mixing length model

(d). Write Navier –Stokes equation for incompressible fluid

(e). Thomas Algorithm

(f). Write a short note on Internal turbulent flow

(g). Write a short note on External Laminar flow

1. Derive an equation for the flow of an incompressible fluid over an isothermal flat plate by using implicit finite difference method
2. Explain

(a). Derive the governing equations for the turbulent flow

(b). Explain K-E model

1. Derive an equation the fully developed laminar flow in a duct
2. Derive an equation for the unsteady state Navier-Stokes equation for incompressible flows
3. Elaborate the following

(a). Explain the flow in a Rectangular Cavity

(b). Explain the flow over a Sphere

1. State the following

(a). Explain Thomas Algorithm with an example

(b). Write a short note on pressure correction

1. Explain the following

 (a). Staggered Grid

 (b). MAC method (c). Discretization of one-dimensional

**CACE-1.1.6 A**

 **MODEL QUESTION PAPER**

**M.Tech (CACE)Degree Examination**

First semester

**ELECTIVE-II: CORROSION ENGINEERING - I**

*(Effective from the admitted batch of 2015-16)*

Time: 3 hours Max. Marks: 70

**Question no. ONE is compulsory and**

**answer any FOUR from remaining questions.**

|  |  |  |
| --- | --- | --- |
| 1 |  | Explain the following in brief |
|  |  |  |
|  | (a) | Ionic conductance |
|  | (b) | Differential aeration cells |
|  | (c) | Intergranular corrosion |
|  | (d) | Calomel Reference half cell |
|  | (e) | Tafel equation |
|  | (f) | Flade potential |
|  | (g) | Pilling-Bed worth ratio |
|  |  |  |
| 2 | (a) | Differentiate between wet and dry corrosion. |
|  | (b) | State faraday’ laws.  |
|  | (c) | Calculate the time required to plate an area of 25 cm2 with a deposit of Copper of 0.1mm thick from a solution containing Cu2+ ions using a current of 0.50 A? The density of copper is 8.9 gm/cc and atomic weight of copper is 63.54. |
|  |  |  |
| 3 | (a) | What are the various regions of activity in Pourbaix diagram for Fe-H20 |
|  | (b) | With a neat diagram write a note on any two reference cells. |
|  |  |  |
| 4 | (a) | Write a note on Activation polarization. |
|  | (b) | For hydrogen evolution reaction the exchange current density is 6.8x10-7 A/cm. If the reaction is proceeding at an overpotential  V calculate the current density. Take the electrode area as 1 cm2 and  |
|  |  |  |
| 5 | (a) | Derive the Stern-Geary equation. |
|  | (b) | For iron (ρ = 7.8 gm/cm3) in a corrosive solution, the linear polarization slope at low current densities equals 2 mV/Acm2. Assuming βa = βc =0.1 V calculate the corrosion current in mpy. |
|  |  |  |
| 6 | (a) | What is passivity and how can the passivity of the metal can be achieved? |
|  | (b) | Write a note on Anodic Protection and Transpassivity. |
|  |  |  |
| 7 | (a) | Explain about the effects of dissolved oxygen and temperature on corrosion of iron in Water. |
|  | (b) | Write about the influence of gases in the atmosphere on corrosion of iron.  |
|  |  |  |
| 8 | (a) | Elaborate on remedial measures to be taken for reduction of corrosion rates of Iron in soils.  |
|  | (b) | Write notes on Protective and non-protective scales |
|  |  |  |

|  |  |  |
| --- | --- | --- |
|  |  | **CACE-1.1.6 B****MODEL QUESTION PAPER****M.Tech Degree Examination**First semester**COMPUTER AIDED CHEMICAL ENGINEERING****ELECTIVE-II: ENERGY ENGINEERING - I***(Effective from the admitted batch of 2015-16)*Time: 3 hours Max. Marks: 70**Question no. ONE is compulsory and****answer any FOUR from remaining questions.** |

1. Write the following
 a) Solar energy as renewable energy
 b) Nuclear fusion
 c) Pyranometer
 d) Local Apparent time
 e) Concentration ratio
 f) Heliostat
 e)energy plantation
2. Explain the method of estimating the radiation on inclined surface.
3. What are flat plate collectors? Classify and mention the advantages and disadvantages of each type. Show and explain its various elements with suitable sketch.
4. Calculate the angle of incidence of beam radiation on flat plate collectors for the following situation:

 Location : Nagpur (21006’N,79003’E)

 Slop of collector : 310

 Date : Dec 1st , 1979

 Time : 09.00hr (IST)

1. What are the concentrating solar collectors, how are they classified? Explain parabolic through concentrator (PTC) with suitable diagram.
2. What is thermo chemical storage? Explain the criteria used for selection of mechanical reaction for solar application.
3. Explain in detail the operation problems associated with solar ponds.
4. (a) Write short notes on working of photovoltaic cell.

(b).A solar cell is made from single crystal silicon and the array consists of 24 modules, each model consists of 36 cells with 10.4x 10.4 cm size. It is given that the inverter efficiency is 85 %. calculate power output in watts.

**CACE- 1.2.1**

**Model question Paper**

**M.Tech (CACE)Degree Examination**

**Second Semester**

**COMPUTER AIDED DESIGN**

**(Common with Computer Aided Chemical Engineering and Industrial Pollution control Engineering)**

 **(Effective from the admitted batch of 2015-16)**

Answer question no. 1 and any other FOUR questions

All questions carry equal marks

Time : 3hrs Max. Marks: 70

1. Write short notes on the following

(a)Time dependent fluids

(b) Sequential modular approach

© Classification of condensers

(d) Extent of reaction

(e) Semibatch reactor

(f) Mean residence time

(g) Pressure drop calculations in two phase flow

1. (a) What is simulation? Explain the advantages of simulation

(b) Write the functions and features of an executive program

1. (a) What is a recycle process? How an executive program identifies recycle in the process?

(b) Write the procedure for sequence of calculation for recycle process with the help of an example

1. Give algorithm for pipeline network calculations
2. Write stepwise procedure for performance calculations in a packed bed absorber.
3. Write an algorithm for the calculation of circulation rate in vertical thermosiphon reboiler.
4. (a) What are the methods used to determine rate equation from the experimental data. Explain them in detail.

(b) Explain the ideal reactor models.

1. Give detailed procedure for simulation of binary distillation column using Mc Cabe Thiele method

**CACE-1.2.2**

**Model Question Paper**

 M.Tech Second semester(Computer Aided Chemical Engineering)

**Sub:Computational Methods**

Time: Three Hours Maximum: 70 Marks

Question ONE is Compulsory

Answer any other FOUR Questions

All Questions carry equal Marks

1.Explain the following

(a) Quasi Newton method (b) Eigen values and Eigen vector

(c) Polynomial interpolation.

(d) What is ordinary differential equation

(e) Bracketing method

(f) Dynamic stability

(g) Norm and rank

2.Explain Jacobian method and explain with an algorithm

3.Explain chemical reaction and diffusion in spherical catalysts pillet

4.What are the Eigen values and Eigen vectors? Solve the eigen values and eigen vectors with a chemical engineering example

5.Explain Gaussian quadrature method with an example

6.Explain the following

 (a) secant method

 (b) Bisection method

 (c) QR method

7.State the following

(a) Explain the accuracy and stability of single step methods

 (b) Explain stiff stability of BDF methods

8.Describe the procedure for finding the of an polynomial with an example

**CACE -1.2.3**

**M.Tech (C.A.C.E) –II Semester**

# Separation Processes

**(Model paper)**

**(Effective from the admitted batch of 2015-16 onwards)**

**Time: 3hours Max.Marks:70**

**Answer question no.1 is compulsory and answer any Four from the remaining.**

**All questions carry equal marks**

1. **Explain the following.**
	1. Explain the difference between the absorption and stripping.

 b. Explain the concept of HETP, HTU and NTU.

 c. What is weeping and entrainment?

d. Overall stage efficiency

e. Selection of solvent in absorption

f. azeotropic distillation

g. Microfiltration

2.(a) Explain Ponchan-savarit graphical stage method for trayed towers.

 (b) Explain rate based models on extractive Distillation briefly.

3 .A trayed tower is to be designed to continuosly distill 204 kmol/h of a binary mixture of 60 mole % benzene and 40 mole % toluene.A liquid distillate and a liquid bottoms product of 95 mole % and 5 mole % benzene,respectively,are to be produced.The feed is preheated so that it enters the column with a molar percent vaporization equal to the distillate to feed ratio.Use the Mc-cabe Thiele method to compute the following,assuming a uniform uniform pressure of 101.3 kPa(1atm) throughout column:

1. minimum number of theoretical stages,Nmin
2. Minimum Reflux ratio,Rmin
3. Number of equilibrium stages for a reflux to minimum reflux ratio of 1.3 and also calculate the optimal feed stage location.

4. 95% of acetone vapor in an 85-volume % air stream is to be absorbed by countercurrent contact with pure water in a valve tray column with an expected overall tray efficiency of 50%. The column will operate essentially at 20 °C and 101 kPa pressure. Equilibrium data for Acetone-water at these conditions are

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mole percent acetone in Water | 3.30 | 7.20 | 11.70 | 17.1 |
| Acetone partial pressure in Air, mmHg | 30 | 62.8 | 85.4 | 103 |

Calculate the following:

1. Minimum value of L’ / V’, the ratio of moles of water per moles of air.
2. Number of equilibrium stages required using a value of L’ / V’ of 1.25 times the minimum.
3. The concentration of Acetone in the exit water.

The remaining specification is the gas feed rate (flow rate) which can be taken on a basis of 100 kmol / hr.

5.Explain in detail about Kremser group method for multicomponent separation.

6. Explain the following

 (a) Super critical extraction

 (b) Binary batch rectification

7.(a) Briefly discuss Fenske-underwood-Gilliland method of multi component

 Separation.

 (b) Explain about packed column efficiency.

8.(a) Explain gas permeation and Calculate mass transfer rates for gas permeation

 (b) Calculate mass transfer rates for pervaporation.

**CACE-1.2.4**

**Model Question Paper**

**MTech (Computer Aided Chemical Engineering )II SEM**

**Optimization**

**(Effective from the admitted batch of 2015-16 onwards)**

 Time: 3 hours Max. Marks: 70

 Question no.1 is Compulsory,

Answer Four questions from remaining questions

1.Explain the following

 a) Optimization

 b) Concave Function

 c) Scanning and Bracketing

 d) Penalty fuction

 e) Global Optimization

 f) Hessian Matri

 g) Legrange Multiplier

2. Suppose you are a chemical distributor who wishes to optimize the inventory of a specialty chemical. You expect to sell ‘Q’ barrels of this chemical over a given year at a fixed price with demand spread evenly over the year. If Q=1,00,000 barrels per year, you must decide on a production schedule. Unsold production is kept as inventory.

3. a)Describe Golden Section method completely

 b)Minimize the function f(x)=x-x2,Starting with x0=0.3,delta =0.1byGolden Section method

4. a)Explain modified Marquardt method of multivariable search.

 b)You are to minimize f(x) = 2x12-4x1x2+x22 and approximate H(x) that is positive definite by Marquardt’s method.

5 Describe the Lagrange multiplier method of solving NLP programming problem

6. Test the following function for necessary and sufficient conditions

Minimize f(x) = (x1-1)2 + x22

 Subject to g1(x)= -x1+ (x22/4)≥ 0 or

 g2(x)= -x1+ x22 ≥ 0

7. Explain the optimization of by genetic algorithms Explain its significance

8. Explain about heuristic search methods for Global Optimization

**CACE-1.2.5 A**

**Model Question Paper**

**M.Tech. DEGREE EXAMINATION**

**Second Semester**

**Nanotechnology**

**(common to Biotechnology and CACE)**

**(Effective from the admitted batch of 2015-16)**

Time: 3 hours Max. Marks: 70

Question No.1 is compulsory

Answer any **Four** from the remaining

All questions carry equal marks

1. Answer the following
2. Distinguish between top-down and bottom-up approaches.
3. Advantage of SEM over TEM.
4. Distinguish between Sol and Gel
5. Distinguish between Catenanes and Rotaxanes.
6. Actuators and flippers.
7. Differentiate between atom and molecule
8. Lipid
9. a. Why C60 fullerence are called bucky ball, give reasons?

b. classify nanotubes, discuss in detail about the properties and applications of nanotubes?

1. a. With the help of neat sketches discuss Moore’s law?

b. write about the differences between quantum computers and classical computers? How does a quantum computer work?

1. What are the differences between DNA and RNA?

b. Explain in detail about the concept of protein based Read and Write cycle?

1. a. Define the term lithography? What are the advantages of optical lithography?

b. Explain the procedure of MBE?

1. Discuss in detail about the working principle of TEM with neat sketches? Add a note on its applications and disadvantages?
2. a. Define LED? Discuss briefly about the optoelectronic devices?

b. write a note on the preparation and importance of ageless materials?

1. a. Explain the term ‘Molecular switches’ properly? Discuss in detail about the different types of molecular switches?

b. explain the structures of lipid with neat sketches?

**CACE-1.2.6 A**

**M.Tech (CACE) – Semester-II**

# Paper: Corrosion Engineering (Elective-II)

**(Effective from the admitted batch of 2015-16 onwards)**

Time: 3hrs Max marks: 70

**Answer question no.1 is compulsory and answer any Four from the remaining.**

1.Explain the following briefly:

 a. Fretting corrosion

 b. passivity

 c. Stress corrosion

 d. Nernst equation

 e. Hydrogen damage

 f. Inhibitors

 g. Decarburization

2. How the corrosion rates are calculated and write detailed notes on corrosion rate expressions?

3. (a) what is crevice and pitting corrosion? Write down its mechanism and prevention methods.

 (b) How do you anodically protect a steel storage tank containing a sulfuric acid?

4. (a)Explain about pitting corrosion and what is autocatalytic nature of pitting.

 (b)What is the main purpose of corrosion testing?

5. (a) Why evaluation of cleanliness of metal surfaces are required.

 (b) What is crevice corrosion? Write down its mechanism and prevention methods

6. Write about

 (a) Mechanical polishing

 (b) Electro polishing

 (c) Explain the concept of metallic cladding

7. What is meant by selective leaching and explain characteristics of dezincification and the mechanism involved.

8. (a) Explain about vapor deposition of metallic coatings.

 (b) Give brief account on phosphate coatings.

**CACE-1.2.6 B**

**M.TECH(CHEMICAL) SECOND SEMESTER**

**(Model Paper)**

 **Elective-II: Energy Engineering – II**

**(With effect from the admitted batch of 2015-16 onwards)**

**Non-conventional Energy Systems**

Answer to Q.No.1 is compulsory. Answer any FOUR from the remaining questions. All questions carry equal marks.

Time: 3 hours Max. Marks: 70

1.Answer briefly to the following

a.Thermoelectricity

b.Classification of fuel cells

c.V – I characteristics of fuel cells

d.Dormancy

e.Magnus effect

f.Phonon

g.Velocity of ocean waves

2.Discuss in detail the method of anaerobic digestion to produce biogas from biomass.

3.With the help of neat diagrams explain several types of wind turbine configurations.

4.Explain wavegen system for obtaining ocean wave energy.

5.(a) Write about OTEC efficiency (b) Discuss the importance of siting in OTEC

6.Enumerate various features of Ceramic Fuel Cells.

7.How gaseous impurities such as hydrogen sulphide, carbon monoxide and carbon dioxide are removed from hydrogen gas?

8.Write short notes on:

1. Hydrogen storage
2. Salination energy

**MBIO-1.1.1**

**MODEL QUESTION PAPER**

**M. Tech (Biotechnology)Degree Examination**

**First Semester**

**ADVANCED MICROBIOLOGY**

**(Effective from the Admitted batch of 2015-2016)**

**Time: 3 Hours Maximum Marks: 70**

**Answer Question No. 1 and any other FOUR Questions from the remaining**

**All Questions carry equal marks**

1. Write short note on :
2. Biological evolution
3. Acid-Fast staining
4. Nomenclature
5. Mycoplasmas
6. Chemolitho heterotroph
7. Transduction
8. Toxin
9. Write briefly origin and evolution of microorganisms?
10. Describe methods and concepts of classification?
11. List out economic importance of microorganisms with suitable examples?
12. Describe the factors that effect growth and control of microorganisms ?
13. Write short notes on
	1. Maintenance and preservation of microorganisms?
	2. Complex and chemically defined media?
	3. Typical bacterial growth curve?
14. Describe water borne diseases and their control?
15. Write briefly on types of microbial toxins, their effects and their control?

**MBIO-1.1.2**

**MODEL QUESTION PAPER**

**M. Tech (Biotechnology)Degree Examination**

**First Semester**

**ADVANCED BIOCHEMISTRY**

**(Effective from the Admitted batch of 2015-2016)**

**Time: 3 Hours Maximum Marks: 70**

**Answer Question No. 1 and any other FOUR Questions from the remaining**

**All Questions carry equal marks**

1. Explain the following in brief :

1. Macromolecular structure of water
2. Denaturation of proteins
3. Co-enzymes
4. Bioenergetic principles
5. Nucleotides
6. Fat soluble vitamins
7. DNA replication

2. Describe the process of origin of biomolecules.

3. a) Describe the structure and properties of polysaccharides.

 b) Write a note on the biological significance of carbohydrates.

4. Explain in detail the structural organization- primary, secondary, tertiary and

 Quaternary structures of proteins.

5. How enzymes are classified? Describe various factors affecting the enzyme

 activity.

6. Describe the mechanism of photosynthesis.

7. What do you understand by the term “biosynthesis”? Describe the process of

 biosynthesis of palmitic acid.

8. Describe the mechanism of RNA biosynthesis (Transcription).

**MBIO-1.1.3**

**M.Tech, I semester, Model Paper**

**Advanced Biochemical Engineering**

**(Effective from the admitted batch of 2015-16 onwards)**

 Time: 3hr Marks: 70

Q.no **1** is compulsory; Answer any **4** questions from the remaining

All questions carry equal marks

1. Write very briefly about the following
2. Deactivation
3. Active transport
4. Dilution rate
5. Pulsed column
6. Entrapment
7. TON
8. Heat transfer correlations
9. a) Derive the Michaelis-Menten equation for an enzyme catalyzed reaction with a

 single substrate.

b) Discuss Heat transfer correlations

1. Discuss different methods of KLa determination.
2. Write the advantages and disadvantages of Biochemical and Chemical Processes.
3. Explain about inter particle and intra particle diffusion.
4. What is immobilization? Explain different methods of enzyme immobilization.
5. Explain complete analysis of a continuous stirred tank reactor.
6. Write notes on two of the following
	1. External mass transfer
	2. Plant cell reactor
	3. Continuous sterilization

MBIO-1.1.4

MODEL QUESTION PAPER

M.TECH BIOTECHNOLOGY (FIRST SEMESTER)

**MBIO-104-ADVANCED DOWN STREAM PROCESSING**

**With effect from the admitted batch of 2015-16 onwards**

**Time: 3Hrs Maximum: 70 marks**

**Question no.1 compulsory and answer any four questions from the remaining**

1) Define the following:

1. Membrane fouling.
2. Critical moisture content.
3. Permeate.
4. Crystal geometry.
5. Retention coefficient.
6. Osmotic Pressure.
7. Supported liquid membrane.

2. (a) explain the action of chemicals in cell disruption.

 (b)Explain the principle involved in reverse phase and hydrophobic interaction chromatographic techniques .

3. (a) Discuss about the various steps involved in Hunter Nash graphical equilibrium

 method.

 (b) Discuss about Super critical fluid extraction with applications and advantages

4. (a) Describe the Oslo crystallization process with neat schematic diagram.

 (b) A hot solution containing 4000kg of Na2CO3 and water with a concentration of 30% by weight Na2CO3  is cooled to 20° c and crystals of Na2CO3 10 H2O are precipitated at 20°c the solubility is 21.5kg anhydrous Na2CO3  per 100kg of water. Calculate the yield of Na2CO3 crystals obtained if 4% of the original water in the system evaporates on cooling.

5. (a) Explain spray dryer with a neat flow diagram?

 (b) A wet solid is to be dried from 60% to 10% moisture under constant drying conditions in 5hr.If the equilibrium moisture content is 4% and the critical moisture content is 15%, how long it will take to dry solids to 6% moisture under the same conditions.

6.a)Discuss briefly about the membrane based separation theory.

 b) Write short notes on ultra filtration with applications.

7. Write a note on freeze drying and its advantages.

8. (a) How reverse osmosis is different from osmosis ? Explain the principle behind reverse osmosis with applications.

(b) Explain the principle, theory and applications of dialysis.

**MBIO-1.1.5 A**

**M.Tech BIOTECHNOLOGY DEGREE EXAMINATION**

**FIRST SEMESTER**

**Elective-I : BIO-ANALYTICAL TECHNIQUES**

**With effect from the admitted batch of 2015-16 onwards**

Time: 3 Hours Max.Marks:70

Answer questions No.1 and any other FOUR questions from the remaining.

All questions carry equal marks.

1. Explain the following in brief.
2. Partition co-efficient.
3. ESR
4. Potentiometric titration
5. Physiological buffers
6. Lyophilization
7. pH
8. Ultafiltration.
9. Explain the principle and technique of Thin Layer chromatography.
10. Describe the Technique and Application of Gas-Liquid chromatography.
11. Give an account on Beer- Lamberts law and its applications. Add a note on preparation of Buffers.
12. Give an account on the determination of PKa values. Add a note on Preparation of Buffers.
13. What is Electrophoresis? Explain.
14. Write notes on:
15. Assay of Nucleic acids.
16. Assay of Amino acids.
17. Give an account NMR and its Applications.

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| --- | --- | --- |
|  |  | **MBIO-1.1.6 A****MODEL QUESTION PAPER****M.Tech Degree Examination**First semester**BIOTECGNOLOGY****ELECTIVE-II: ENERGY ENGINEERING - I***(Effective from the admitted batch of 2015-16)*Time: 3 hours Max. Marks: 70**Question no. ONE is compulsory and****answer any FOUR from remaining questions.** |

1. Write the following
 a) Solar energy as renewable energy
 b) Nuclear fusion
 c) Pyranometer
 d) Local Apparent time
 e) Concentration ratio
 f) Heliostat
 e)energy plantation
2. Explain the method of estimating the radiation on inclined surface.
3. What are flat plate collectors? Classify and mention the advantages and disadvantages of each type. Show and explain its various elements with suitable sketch.
4. Calculate the angle of incidence of beam radiation on flat plate collectors for the following situation:

 Location : Nagpur (21006’N,79003’E)

 Slop of collector : 310

 Date : Dec 1st , 1979

 Time : 09.00hr (IST)

1. What are the concentrating solar collectors, how are they classified? Explain parabolic through concentrator (PTC) with suitable diagram.
2. What is thermo chemical storage? Explain the criteria used for selection of mechanical reaction for solar application.
3. Explain in detail the operation problems associated with solar ponds.
4. (a) Write short notes on working of photovoltaic cell.

(b).A solar cell is made from single crystal silicon and the array consists of 24 modules, each model consists of 36 cells with 10.4x 10.4 cm size. It is given that the inverter efficiency is 85 %. calculate power output in watts.

**MBIO-1.2.1**

**MODEL PAPER**

 M.Tech II Semester Biotechnology

**GENETIC ENGINEERING**

**(With effect from the admitted batch of 2015-16 onwards)**

Time:3 hrs Max. Marks:70

***Question No.1 is compulsory***

***Answer any FOUR from the remaining***

***All questions carry equal marks***

1. Write short notes on
2. Gene manipulation
3. Reverse transcriptase
4. Plasmid
5. Genetic code
6. Gene library
7. Gene cloning in mammalian cells
8. Southern Blotting
9. Give an account of cloning vectors and their role in gene cloning
10. Explain in detail the different cloning strategies
11. Describe in detail about the micro injection of genes into oocytes, eggs and embryo.
12. Write an account of the enzymology of gene cloning
13. Write an essay on the expression of cloned genes
14. Write short notes on:
15. Regulation of gene expression
16. cDNA library
17. Write a note on applications of genetic engineering in biology and medicine

**MBIO-1.2.2**

**MODEL PAPER**

 M.Tech II Semester Biotechnology

**ENZYME ENGINEERING**

**With effect from the admitted batch of 2015-16 onwards**

Time:3 hrs Max. Marks:70

Answer any FIVE questions

First question is compulsory

1. Explain:
2. Enzyme
3. Chromatography
4. Cofactors of an enzyme
5. Dialysis
6. Precipitation
7. Applications of enzymes
8. Immobilization
9. How are enzymes classified? Describe their nomenclature.
10. Derive Michaeli’s- Menten equation. Write briefly various methods for evaluation of Michaeli’s- Menten parameters.
11. Define enzyme inhibition. What are the types of inhibitions? Derive Non-competitive inhibition and write in the Michaeli’s- Menten form.
12. What are the various sources of enzymes? Write them briefly.
13. Write the techniques used for the enzyme extraction from plant, animal and microbial source.
14. Explain the techniques of enzyme purification.
15. What is immobilization of enzyme? Explain the various methods of immobilization.

**MBIO-1.2.3**

**MODEL PAPER**

 M.Tech II Semester Biotechnology

**ENVIRONMENTAL BIOTECHNOLOGY**

**With effect from the admitted batch of 2015-16 onwards**

Time:3 hrs Max. Marks:70

Answer any FIVE questions

First question is compulsory

1.Write short notes on :

a. Ecosystem

1. Sludge
2. Acid rain
3. Biotransformation
4. Energy crops
5. Bioleaching
6. Hot spots of biodiversity

2.Write on sources, effects and control of air pollutants?

3.Describe advanced solid waste management techniques?

4.Explain role of genetic engineering in bioremediation?

5.Write short notes on

* 1. Phytoremediation ?
	2. Global warming?
	3. Bio ethanol?

6.Write on renewable sources of energy with suitable examples?

7.Explain the role of microorganisms in bioabsorption of metals and discuss the limitations?

8.Write short notes on:

* 1. Biopolymers?
	2. Biosensors?
	3. Conservation of biodiversity?

**MBIO-1.2.4**

**MODEL PAPER**

 M.Tech II Semester Biotechnology

**NANO TECHNOLOGY**

**(With effect from the admitted batch of 2015-16 onwards)**

Time:3 hrs Max. Marks:70

Question No.1 is compulsory

Answer any **Four** from the remaining

All questions carry equal marks

1.Answer the following

a.Distinguish between top-down and bottom-up approaches.

b.Advantage of SEM over TEM.

c.Distinguish between Sol and Gel

d.Distinguish between Catenanes and Rotaxanes.

e.Actuators and flippers.

f.Differentiate between atom and molecule

g.Lipid

1. a. Why C60 fullerence are called bucky ball, give reasons?

b. classify nanotubes, discuss in detail about the properties and applications of nanotubes?

1. a. With the help of neat sketches discuss Moore’s law?

b. write about the differences between quantum computers and classical computers? How does a quantum computer work?

1. What are the differences between DNA and RNA?

b. Explain in detail about the concept of protein based Read and Write cycle?

1. a. Define the term lithography? What are the advantages of optical lithography?

b. Explain the procedure of MBE?

1. Discuss in detail about the working principle of TEM with neat sketches? Add a note on its applications and disadvantages?
2. a. Define LED? Discuss briefly about the optoelectronic devices?

b. write a note on the preparation and importance of ageless materials?

1. a. Explain the term ‘Molecular switches’ properly? Discuss in detail about the different types of molecular switches?

b. explain the structures of lipid with neat sketches?

**MBIO-1.2.5 A**

**MODEL QUESTION PAPER**

**M. Tech Degree Examination**

**Biotechnology**

**Second Semester**

**ELECTIVE-II INDUSTRIAL BIOTECH PRODUCTS**

**(Effective from the Admitted batch of 2015-2016)**

**Time: 3 Hours Maximum Marks: 70**

**Answer Question No. 1 and any other FOUR Questions from the remaining**

**All Questions carry equal marks**

1. Write briefly on the following:
2. Antibiotics
3. CSTR
4. Synthetic Media
5. Inoculum
6. Coenzyme
7. Baker’s Yeast
8. Aerobic fermentation
9. Explain in detail about batch fermentation of media with a suitable example.
10. Describe the production of alcohol from starchy substrate by fermentation.
11. Describe the production of industrially important enzymes by fermentation.

1. Explain the fermentative production of Lactic acid.

6. a) How the specific microbial strain required for the fermentation is selected?

b) Describe the purification process of fermented broth.

 7. Describe the production of any two antibiotics by fermentation.

 8. Write notes on following:

 a) Dairy products

 b) Production of wine from grapes by fermentation.

**MBIO-1.2.6 B**

**M.TECH(IPCE) SECOND SEMESTER**

**(Model Paper)**

 **Elective-II: Energy Engineering – II**

**(With effect from the admitted batch of 2015-16 onwards)**

**Non-conventional Energy Systems**

Answer to Q.No.1 is compulsory. Answer any FOUR from the remaining questions. All questions carry equal marks.

Time: 3 hours Max. Marks: 70

1.Answer briefly to the following

(a)Thermoelectricity

(b)Classification of fuel cells

©V – I characteristics of fuel cells

(d)Dormancy

(e)Magnus effect

(f)Phonon

(g)Velocity of ocean waves

2.Discuss in detail the method of anaerobic digestion to produce biogas from biomass.

3.With the help of neat diagrams explain several types of wind turbine configurations.

4.Explain wavegen system for obtaining ocean wave energy.

5(a) Write about OTEC efficiency (b) Discuss the importance of siting in OTEC

6.Enumerate various features of Ceramic Fuel Cells.

7.How gaseous impurities such as hydrogen sulphide, carbon monoxide and carbon dioxide are removed from hydrogen gas?

8.Write short notes on:

a.Hydrogen storage

b.Salination energy