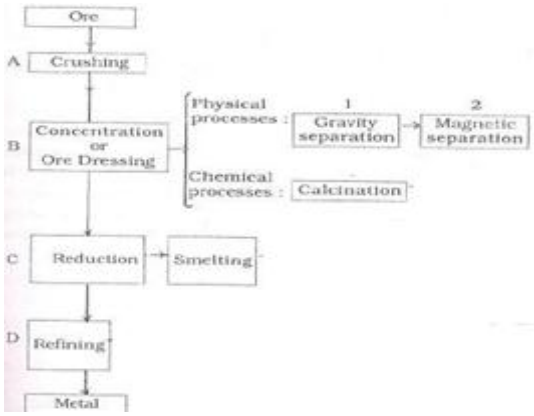
SUMMER– 17 EXAMINATION

Model Answer

Subject Code: 17203

Important Instructions to examiners:

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

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any nine of the following:**	**18**
	(a)	**Write sequential steps involved in extraction of Iron from its ore.**	**2**
			2
	(b)	**What are the products of blast furnace?** i) Pig Iron ii) Slag iii) Flue Gases **(consider any two)**	**2** 2
	(c)	**Define hardening. State its two purposes.** **Hardening:** In this process, steel is heated to high temperature (800-900^{0}C) and then suddenly cooled by dipping or quenching in some suitable medium.	**2**
		The purposes of hardening are: i)To increase its resistance to wear or abrasion and ability to cut other metals.	1
		ii)To improve strength, elasticity, ductility and toughness.	1

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(d)	**Give two applications of Alnico.** i) It is used for making strong permanent magnets like electric motors, microphones etc. ii) It is used in transformer cores, dynamos etc. iii) It is used for making small powerful permanent magnets for magneto loud speakers, radio and T.V. sets.	**2** 1 mark each
	(e)	**Define corrosion. Write its types.** **Corrosion:** "Any process of chemical or electrochemical decay or destruction of a metal due to the action of surrounding medium is called as corrosion." **Types of corrosion:** i) Atmospheric corrosion / Direct chemical / Dry corrosion ii) Immersed corrosion / Electrochemical corrosion / Wet corrosion	**2** 1 1
	(f)	**State the types of oxide films in corrosion. Name more protective oxide film.** **Types of oxide films:- (any two)** i) Stable film:- 1) Porous ii) Non-porous ii) Unstable film iii) Volatile film **Protective Oxide films:- (any one)** a. Non – Porous oxide film b. Unstable oxide film	**2** 1 1
	(g)	**Define paint. Write two constituents of paints.** **Paint**- It is a mechanical dispersion mixture of one or more pigments in a vehicle. **Constituents of paint**:- (**Any two**) i) Pigments ii) Drying Oil / Medium iii) Thinner iv) Driers v) Extenders vi) Plasticizers	**2** 1 ½ mark each
	(h)	**Why galvanized containers are not used to store food stuff.** Galvanized container contains zinc coating. Since zinc is more active metal it readily reacts with the acids present in the food stuffs forming zinc compounds which are highly poisonous & it may poison the food stuffs. Therefore galvanized containers cannot be used for storing food stuff.	**2** 2

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1	(i)	**Define calorific value & ignition temperature.**	2
		Calorific value: The total amount of heat produced by the complete combustion of unit weight or unit volume of the fuel is known as calorific value.	1
		Ignition temperature: The minimum temperature at which combustion of a fuel takes place when the firing is once started is known as ignition temperature.	1
	(j)	**Give two purposes of proximate analysis.**	2
		Proximate analysis provides following valuable information in assessing the quality of fuel i) To determine moisture content in fuel. ii) To determine volatile Matter iii) To determine ash content in coal sample. iv) To determine fixed carbon	1 mark each
	(k)	**Write two applications of biogas.**	2
		i) It is used as a fuel for heating & cooking purpose. ii) Biogas can be used to run any type of heat engine in order to generate electrical or mechanical power. iii) It is used as an illuminant in villages. iv) It provides excellent yield of manure during its manufacturing.	1 mark each
	(l)	**Define lubricant. Write its types**.	2
		Lubricant:- Any substance introduced between two moving or sliding surfaces to reduce the frictional resistance between them is known as a lubricant.	1
		Types of Lubricant:- i) Solid lubricant ii) Semi-solid lubricant iii) Liquid lubricant.	1
2		**Attempt any four of following.**	16
	a)	**Write chemical reaction taking place in the zone of reduction of blast furnace.**	4
		The reduction is done in stages as given below:- $Fe_2O_3 \rightarrow Fe_3O_4 \rightarrow FeO \rightarrow Fe$ i) In between 300 – 500^{0}C, when charge is heated, Fe_2O_3 (Ferric oxide) is reduced to Fe_3O_4 (Ferroso ferric oxide). $3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$ This Fe_3O_4 is stable upto 650^{0}C in presence of CO, CO_2 & free coke. ii) In between 650 – 700^{0}C, Fe_3O_4 is reduced to FeO $Fe_3O_4 + CO \rightarrow 3FeO + CO_2$ iii) At temperature between 700 – 800^{0}C, FeO is reduced to metallic iron. $FeO + CO \rightarrow Fe + CO_2$ iv) Simultaneously, the limestone present in the charge is decomposed to produce lime. $CaCO_3 \rightarrow CaO + CO_2$	1 mark each

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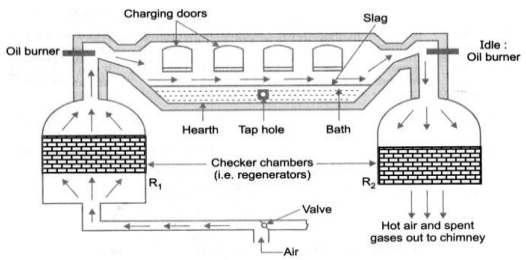
2		v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe_2O_3 or Fe_3O_4. $2Fe + 3CO \rightarrow Fe_2O_3 + 3C$. $3Fe + 4CO \rightarrow Fe_3O_4 + 4C$. **(Note: Write any four reactions)**	
	(b)	**How is the steel is prepared from pig iron using open hearth process?**	**4**
		Procedure:-1) The charge consists of pig / cast iron (Cold or molten), scrap iron / steel & hematite (Ore). 2) Heating the charge on the hearth of furnace by the heat produced by burning fuel in air or by producer gas. 3) First Phase of Cycle: -Producer gas / air is passed through previously heated regenerator (R) while the products of combustion flow through the regenerator. 4) The charge is fed through a charging door & heated to 1600^0C to 1650^0C by means of producer gas. Fuel is fired through nozzles. 5) The hot gases formed in (R_1) pass over the hearth to its opposite end & metal charge supported on the hearth is openly exposed to the flames & is converted into molten metal. Metal charge is also heated by the radiations from the walls. 6) After passing over the hearth, the products of combustion pass through R_2 (Checker chamber) & heat it after about 25 to 30 min. 7) Second Phase Cycle**:-**Idle burner fires the fuel. 8) Regenerators R_1, R_2 store & release large quantities of heat which would have escaped to the atmosphere & thus wasted. 9) Tap hole in the lowest part of the hearth always closed with refractory plug until metal is ready to be poured.	2
		Reaction:- a) Oxidation of impurities of Mn, P and Si by hematite $2Fe_2O_3 + 3Mn \rightarrow 2Fe + 3MnO$ ↑ $5\ Fe_2O_3 + 6P \rightarrow 10Fe + 3P_2O_5$ ↑ $2Fe_2O_3 + 3Si \rightarrow 4Fe + 3SiO_2$ ↑ a) Formation of slag for the removal of Mn, P & Si. $MnO + SiO_2 \rightarrow MnSiO_3$ $P_2O_5 + 3CaO \rightarrow Ca_3(PO_4)_2$ $SiO_2 + CaO \rightarrow CaSiO_3$	1
		b) Finally C & S from gaseous oxides which leave the furnace as five gases $2\ Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$ ↑ $2Fe_2O_3 + 3S \rightarrow 4Fe + 3SO_2$ ↑	1



Q. No.	Sub Q. N.	Answer	Marking Scheme
2	(c)	**Differentiate between annealing and normalizing.**	4

Annealing	Normalizing
1. It is the process of heating the steel at a temperature (760- 925^{0}C) and cooling it slowly in the furnace along with the furnace.	1.It is the process of heating the steel at a temperature of 50 ^{0}C above the critical temperature (725^{0}C) and cooling it freely in air at a rate of 5 ^{0}C/Sec.
2. Due to annealing steel becomes more soft, pliable, malleable & ductile.	2. Due to normalizing steel becomes homogeneous & more soft. The mechanical properties of steel are more improved than annealing.
3.Time required for annealing is more than normalizing.	3.Time required for normalizing is less than annealing.
4. Consumption of fuel or electric power is more.	4. Consumption of fuel or electric power is less.

1 mark each

	(c)	**Write the four characteristics of good fuel.** **Characteristics:** 1) A good fuel should have a high calorific value. 2) A good fuel should have a moderate ignition point. 3) A good fuel should not liberate any polluting or poisonous product gases. 4) The velocity of combustion should be moderate. 5) The combustion should be easily controllable. 6) It should contain low percentage of non-combustible matter. 7) It should be cheap, easily available & convenient for transportation. 8) A good fuel requires smaller space to store. 9) A good fuel does not contain any volatile matter which causes air pollution.	4 1 mark each
	(d)	**Explain the process of determining percentage of moisture and volatile matter in coal sample by proximate analysis.** **1) Percentage of Moisture:-** i) About 1 gm of finely powdered air- dried coal sample is weighed (W g) in a crucible. ii) The crucible is placed in an electric hot oven for 1 hour at 105^{0}C.	4

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		iii) Cool it to room temp in a dessicator & weighed it again (W1 g). iv) Loss in weight (W – W1 g) is due to loss of moisture from the coal. % of moisture = $\frac{\text{Loss in weight}}{\text{Weight of coal sample}}$ x 100 = (W-W1) / W x 100	**2**
		2**) Percentage of Volatile Matter (V.M.):-** i) The above sample of moisture free coal left in crucible (W1g) is covered with a lid. ii) Then the crucible is placed in a muffle furnace at 925^0C for 7 min. iii) Cool it in desiccator to room temp & weigh it again (W2g) (Without lid) % of Volatile matter = $\frac{\text{Loss in weight}}{\text{Weight of coal sample}}$ x 100 = (W1-W2) / W x 100	2
	(f)	**Write composition, properties and applications of LPG.** **Composition:** 1) Ethane = 0.20% 2) Propane = 57.30% 3) Butane = 41.10% 4) Pentane = 1.40%	**4** 2
		Properties:- 1) It is highly inflammable. 2) LPG is colorless, odorless gas. 3) Its calorific values it very high. 4) It is non- corrosive to steel & copper alloys. 5) It does not produce any harmful product on combustion. 6) It is slightly toxic and anesthetic if inhaled in large Concentration.	1
		Applications:- 1) LPG is mainly used as a domestic fuel & industrial fuel. 2) It is also used as motor fuel. 3) It is also used in aerosol industries. 4) It is used in portable blow lamps, soldering, welding, brazing & steel Cutting etc. **(Any two properties and two applications 1 mark each)**	1

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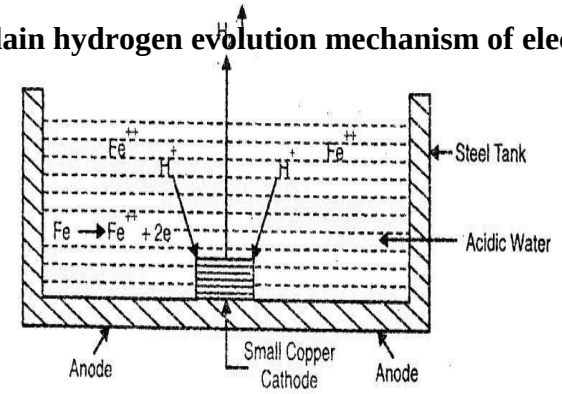
3.		**Attempt any four of the following :**	**16**
	(a)	**Explain hydrogen evolution mechanism of electrochemical corrosion.**	**4**
			1
		Steel tank: - Anode **Cu – strip:- Cathode** Such type of corrosion occurs usually in acidic environments like acidic industrial waste, solutions of non – oxidizing acids. Consider a steel tank containing acidic industrial waste and small piece of copper scrap in contact with steel. The portion of the steel tank in contact with copper is corroded most with the evolution of hydrogen gas.	1
		Reactions: **At Anode:** **$Fe \rightarrow Fe^{++} + 2\ e^{-}$** These electrons flow through the metal from anode to the cathode	**1** 1
		At cathode H^{+} ions are eliminated as H_2 gas **$2H^{+} + 2\ e^{-} \rightarrow H_2\uparrow$ (Reduction)** Thus, over all reaction is **$Fe + 2H^{+} \rightarrow Fe^{++} + H_2\uparrow$** **[Note: 1mark each to be given to reaction at anode & cathode.]**	

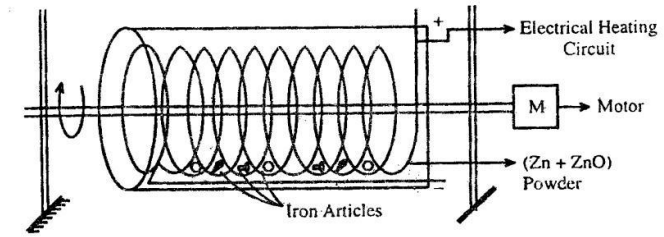
Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	(b)	**Distinguish between galvanizing and tinning.**	4

Sr. No.	Galvanizing	Tinning
i)	A process of covering iron or steel with a thin coat of **Zinc** to prevent it from rusting.	A process of covering iron or steel with a thin coat of **Tin** to prevent it from corrosion.
ii)	In galvanising, zinc protects the iron as it is more electropositive than iron. It does not allow iron to pass into solution.	Tin protects base metal iron from corrosion, as it is less electropositive than iron and higher corrosion resistance.
iii)	In galvanizing Zn continues to protect the metal by galvanic cell action, even if coating of Zn is broken.	In tinning, tin protects the iron, till the coating is perfect. Any break in coating causes rapid corrosion.
iv)	Galvanized containers can not be used for storing acidic food stuff, since Zn reacts with food acids forming Zn compounds which are highly toxic i.e. poisonous.	Tin coated containers and utensils can be used for storing any food stuff since Tin is non toxic and protects the metal from corrosion and does not causes food poisoning.

1 mark each

(c) **Describe sherardizing process for protection of small articles of iron from corrosion. Write its two applications.** — **4**

The method used to coat small and irregular shaped articles is **sherardizing.**



1

Process:

i) The iron articles (bolts, screws, nails etc) to be coated are first cleaned and then packed with Zn dust and ZnO powder in a steel drum, which is provided with electrical heating circuit arrangement.

ii) The drum is slowly rotated for 2-3 hours and its temp is kept between 350 – 400^{0}C during this process Zn gets diffused slowly into iron forming Fe - Zn alloy at the surface which protects iron surface from corrosion.

2

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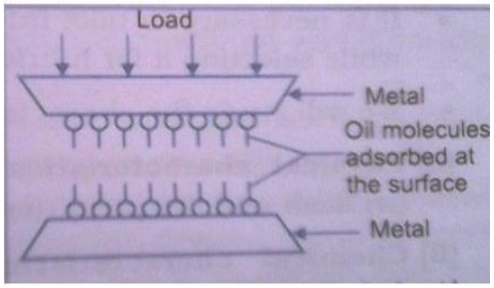
Q. No.	Sub Q. N.	Answer	Marking Scheme
3		**Application:** i) It is used for protecting small steel articles like bolts, screws, nuts, threaded parts, washers, valves, gauge, tools etc. ii) Coating is quite uniform & does not produce any crevice or crack.	**1**
	(d)	**Define following properties of lubricant:** **i) Flash Point ii) Fire point** **iii) Oiliness iv) Viscosity index.** **i) Flash Point: -** The minimum temperature at which the oil gives enough vapours which give momentary flash of light when a flame is brought near it. **ii) Fire Point: -** "Fire point of an oil is the minimum temperature at which the oil gives enough vapours which catch fire & burn continuously atleast for five seconds when a flame is brought near it." **iii) Oiliness:** -It is defined as the power of an oil to maintain a continuous film under pressure while used a lubricant. **iv)Viscosity Index:** The rate of change of viscosity of a liquid (Oil) with the change of temperature is known as viscosity index.	**4** 1 mark each
	(e)	**Explain Boundary lubrication process with diagram.** **Mechanism:** This type of lubrication is done when a continuous fluid film of lubricant cannot persist & direct metal to metal contact is possible due to certain reasons. This happens when i) a shaft starts moving from rest or ii) the speed is very low or iii) the load is very high or iv) The viscosity of oil is too low. Under such conditions, the space between the moving parts is lubricated with a thin layer of oil lubricant. The oil is adsorbed by physical or chemical forces or both on the metallic surfaces. The adsorbed layers cannot get removed easily & thus avoids direct metal to metal contact. The load is carried by the layers of the adsorbed lubricant on the metallic surfaces. The property which is responsible for this kind of adsorption is "Oiliness".  	**4** 3 1

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3	(f)	**Select the lubricants for following mechanical jobs.** **i) Sewing machine ii) Road rollers** **ii) Cutting tools iv) Gears**	4
		i) Sewing machines: Thin vegetable & animal oils like palm oil, hazel nut oil, neat foot oil, olive oil etc. are used.	1
		ii) Road Rollers: Solid lubricants such as graphite, soap stone, mica used in form of dry powder or emulsion, molybdenum disulphide etc.	1
		iii) Cutting tools: Mineral oil containing additives like fatty oils and oil-emulsions are used.	1
		iv) Gears: Thick Mineral Oil containing extreme pressure additives are used.	1