WINTER– 16 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)	**Define heat treatment. State its two purposes.**	**(2)**
		Heat Treatment: It is the process of heating steel to a certain high temperature and then cooling it at a controlled rate, in order to develop certain desirable physical properties in it without changing its chemical composition.	1
		Purpose of heat treatment:- 1) To change the structure of steel, 2) To increase surface hardness. 3) To increase resistance to heat & corrosion. **(State any two relevant purposes)**	1
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	b)	**Name various products of Blast furnace?**	**(2)**
		i) Pig Iron ii) Slag iii) Flue Gases	2
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	c)	**Give composition of Pig iron**	**(2)**
		Composition: i) Iron: 92-94% ii) Carbon: 2.5- 4.5% iii) Silicon: 0.7 – 3% iv) Phosphorus: 0.5 -1 % v) Manganese: 0.2- 1% vi) Sulphur: 0.1 -0.3%	2

Q. No.	Sub Q. N.	Answer	Marking Scheme
	d)	**Give composition of HSS**	**(2)**

1. 18-4-1 HSS W-18% Cr-4% V-1% Remaining steel with 0 .75% C	**2. Cobalt HSS** Alloy Steel containing 5-8% Co
3. Vanadium HSS Alloy Steel containing more than 1% V and 0.7% C	4. **Molybdenum HSS** Mo-6% W-6% Cr-4% V-20% Remaining is steel

2

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e) **Name the various oxide films. Classify them in to protective and non protective.** **(2)**

Type of Oxide film	**Protective value**
1) Stable film porous oxide film	Non protective
2) Stable non – porous oxide film	Protective
3) Unstable oxide film	Protective
4) Volatile oxide film	Non protective

1/2 Mark each

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f) **Why tinned containers are used to store the food stuffs?** **(2)**

Since tin is less active metal, It does not react with the food stuffs to form poisonous compounds. So tinned containers are used to store food stuff.

2

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g) **How galvanizing is different from sherardizing?** **(2)**

Galvanizing	**Sherardizing**
1 It is process of coating iron or steel sheets with a thin coat of zinc by hot dipping method	1 It is process of coating small iron or steel articles by alloying at surface with zinc metal
2 In galvanizing surface of iron sheet is covered by a thin layer of zinc metal which protect the base metal from corrosion	2 In sherardizing surface of iron or steel article is covered by a Zinc- iron alloy layer which protect the base metal from corrosion

1 Mark each

Q. No.	Sub Q. N.	Answer	Marking Scheme
		3 This process is carried out in a large tanks by dipping iron sheet in a bath of molten zinc at a temperature of about 425-460^0 c | 3 This process is carried out in a constantly rotating drum by packing the small iron or steel article in zinc powder at a temperature of about 350 -400^0 c 4 This process is widely used for protecting iron articles like fencing wires, roofing sheets etc. | 4.This process is used for protecting small & irregular iron articles like bolts, screws, nails, nuts etc. **(Note: Any two points)**	
	h)	**Give four characteristics of good paint.** **Characteristics of good paint.:-** 1) It should be able to resist the atmospheric conditions. 2) Paint should have desired consistency. 3) It should have high hiding power. 4) Its film should be washable. 5) Its film should not crack or shrink on drying 6) It should form uniform, nonporous, adherent, durable and glossy film. 7) When paint is applied on a metal it should resist corrosion. **(Note: write any four points)**	**(2)** ½ Mark each
	i)	**Give composition of LPG** **Composition:-** The average composition of LPG is 1)Ethane = 0.20% 2)Propane = 57.30% 3) Butane = 41.10% 4)Pentane = 1.40%	**(2)** ½ Mark each
	j)	**Define flash point and fire point.** **Fire Point: -** "Fire point is the minimum temperature at which the oil gives enough vapours which catch fire & burn continuously at least for five seconds when flame is applied to it." **Flash Point: -** Flash point of oil is the lowest temperature at which the oil begins to give enough vapours which give momentary flash of light when a flame is applied to it.	**(2)** 1 1
	k)	**List four expectations from good lubricant.** 1. It should avoid direct contact between the rubbing surfaces and hence reduce the surface wear & tear & deformation. 2. It should reduce the loss of heat, so it acts as a coolant. 3. It should reduce expansion of metal by local frictional heat	**(2)** ½ Mark each

Q. No.	Sub Q. N.	Answer	Marking Scheme
		4. It should reduce unsmooth relative motion. 5. It should reduce the maintenance & running cost of machine. 6. It should reduce the power loss in I.C. engine.	
	I)	**How CNG is more economical than other fuel.** CNG is compressed natural gas which is used in transport sector. It's calorific value is 8000 to 14000 kcal/m^3. It is cheaper than petrol & diesel As.it is free from lead & sulphur it is more environmentally clean and safer than other fuels. So it is more economical than other fuels.	**(2)** 2
2		**Attempt any four of the following:**	**16**
	a)	**List various zones of blast furnace. Give reactions involved in zone of reduction with temperature** **Various zones of blast furnace:-** 1. Zone of reduction 2. Zone of heat absorption 3. Zone of fusion **Reactions in the zone of reduction of blast furnace.** The reduction of iron oxide is done in the following stages:- $Fe_2O_3 \longrightarrow Fe_3O_4 \longrightarrow FeO \longrightarrow Fe$ 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). $3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2 \uparrow$ 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 $Fe_3O_4 + CO \longrightarrow 3FeO + CO_2 \uparrow$ iii) At temperature between **700 – 800^{0}C**, FeO is reduced to metallic iron. $FeO + CO \longrightarrow Fe + CO_2 \uparrow$ iv) Simultaneously, the limestone present in the charge is also decomposed to produce lime. $CaCO_3 \longrightarrow CaO + CO_2 \uparrow$ v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe_2O_3 or Fe_3O_4. $2Fe + 3CO \longrightarrow Fe_2O_3 + 3C$ $3Fe + 4CO \longrightarrow Fe_3O_4 + 4C$ **(Note: consider any three reactions)**	**(4)** 1 3

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Q. No.	Sub Q. N.	Answer	Marking Scheme
	b)	**Give the difference between annealing 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 homogenous & 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

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c) **Describe open hearth process for steel.** **(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^{0}C to 1650^{0}C 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 — 2
7) Second Phase Cycle**:-**Idle burner fires the fuel.
8) Regenerators R_1, R_2store & 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.

Reaction:- a) Oxidation of impurities of Mn, P and Si by hematite — 2

$2Fe_2O_3 + 3Mn \rightarrow 2Fe + 3MnO$

$5\ Fe_2O_3 + 6P \rightarrow 10Fe + 3P_2O_5$

$2Fe_2O_3 + 3Si \rightarrow 4Fe + 3SiO_2$

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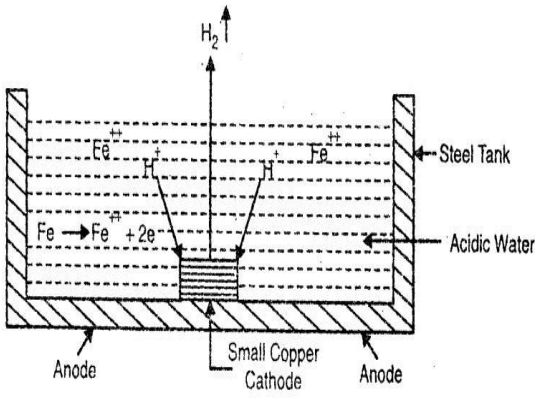
Q. No.	Sub Q. N.	Answer	Marking Scheme
		a) Formation of slag for the removal of Mn, P & Si. $MnO + SiO_2 \rightarrow MnSiO_3$ $P_2O_5 + 3CaO \rightarrow Ca_3(PO_4)_2$ } Slag $SiO_2 + CaO \rightarrow CaSiO_3$ b) Finally C & S from gaseous oxides which leave the furnace as five gases $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2\uparrow$ $2Fe_2O_3 + 3S \rightarrow 4Fe + 3SO_2\uparrow$	
	d)	**Differentiate between solid liquid gaseous fuels.**	**(4)**

Property	**Solid**	**Liquid**	**Gaseous**
1.Calorific Value	Low	Higher	Highest
2.Ignition Temperature	Very high	Moderate	Very low
3.Cost	Cheapest	Costly	Costlier
4.Ash content	High	Negligible	Nil
5.Velocity of combustion	Non controllable	Easily controllable	Easily controllable
6.Volatile matter & moisture	Large	Negligible	Nil
7. Transportation	Laborous but risk free	Can be piped but risky	Can be piped but very risky
8. Storage	Large space but no risk of fire	Small space but risk of fire hazard	Very large space & very high risk of fire hazard
9.Efficiency	Very low	High	Highest
10 Smoke	Burn with smoke	Nigligible	No Smoke
11 Use in I.C.Engine	Can not be used	Can be used	Can be used
12 Pollution	Large	Lesser	Least

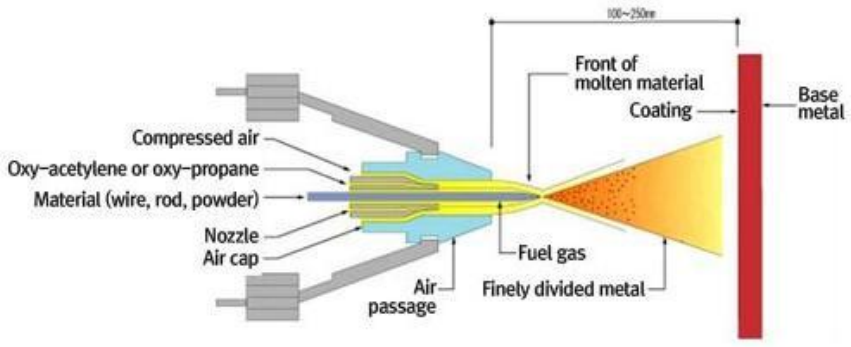
1 Mark each

(Note: consider any four points)

Q. No.	Sub Q. N.	Answer	Marking Scheme
	e)	**Explain proximate analysis matter in coal sample for determining moisture and volatile.**	**(4)**
		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 105^0C. iii) Cool it to room temp in a desiccator & weighed it again (W_1 g). iv) Loss in weight ($W - W_1$ g) is due to loss of moisture from the coal. % of moisture = $\frac{\text{Loss in weight x 100}}{\text{Weight of coal sample}}$ = $(W-W_1) / W \times 100$	2
		2) Percentage of Volatile Matter (V.M.):- i) The above sample of moisture free coal left in crucible (W_1g) 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. (W_2g) (Without lid) % of Volatile matter = $\frac{\text{Loss in weight x 100}}{\text{Weight of coal sample}}$ = (W1-W2) / W x 100	2
	f)	**Give composition, properties and applications of Biogas.**	**(4)**
		The average composition of biogas is: CH_4 (methane) = 50 – 60% (Combustible gas) CO_2 (carbon dioxide) = 30 – 40% (non – combustible gas) H_2 (hydrogen) = 5 – 10% (Combustible gas) N_2 (nitrogen) = 2-6% (non – combustible gas) H_2S (Hydrogen sulphide) = traces (Combustible gas)	2
		Properties:- (any one) a) Biogas on burning liberates a larger amount of heat than thatobtained by burning animal dung or fire wood directly. b) It burns without producing residue, smoke etc. c) It is cheap, clean in use, has good calorific value & convenient fuel. d) It does not pollute the atmosphere. e) It involves no storage problem. f) Biogas production is very economical. g) It provides excellent yield of good manure	1

Q. No.	Sub Q. N.	Answer	Marking Scheme
3		**Applications:- (any one)** a) It is used as an efficient fuel. b) It is used for cooking food. c) It is used as an illuminant in villages. d) To run engines (generators). --- **Attempt any FOUR of the following:**	1 **16**
	a)	**Explain stepwise mechanism of electrochemical corrosion due to evolution of Hz gas ? with labeled diagram).**	**(4)**
			1
		Steel tank: - Anode **Copper strip:- Cathode** These types of corrosion occur usually in acidic environments like 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 acts as anode & is corroded most with the evolution of hydrogen gas. **Reactions:** **At Anode:** **$Fe \longrightarrow Fe^{++} + 2e^-$ (Oxidation)** These electrons flow through the metal from anode to the cathode that is piece of copper metal where they are accepted by H^+ ions to form H_2 gas **At cathode :** H^+ ions are eliminated as H_2 gas **$2H^+ + 2e^- \longrightarrow H_2\uparrow$ (Reduction)** Thus, over all reaction is **$Fe + 2H^+ \longrightarrow Fe^{++} + H_2\uparrow$** ---	1 1 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
	b)	**Describe the process of metal spraying with its advantages and disadvantages**	**(4)**



1

Process:- In this method ,coating metal sprayed on the surface of base metal with the help of spraying gun or pistol.The spraying gun consist of a duct for compressed air and is fitted with the oxy- hydrogen flame. The coating metal in the form of wire is fed into the gun which is then melted inside the gun with the help of oxy hydrogen flame. The molten metal then sprayed on the surface of base metal with the help of compressed air.

1

Advantages:-

1 Thickness of coating can be controlled

2 Irregular surfaces can be covered easily

1

3 Metallic coating can be applied on non-metallic surfaces like glass, plastic rubber etc.

4 Coating can be applied on fabricated structures & there will be no possibility of damage of coating during the assembly of parts

5 Warn out machine parts can be repaired by metal spraying

Disadvantages:-

1 Coating may be porous

1

2 Coating may be less adherent

Q. No.	Sub Q. N.	Answer	Marking Scheme
	c)	**How will you protect following from corrosion?**	**(4)**
		(i) Underground pipe line	
		(ii) Iron machinaries	
		Underground pipe line:- It can be protected from corrosion by using a) **Sacrificial anode method-** In this method the iron pipe to be protected is made cathodic by connecting it to more active metals like Zn/ Mg/ Al. b) **Impressed current method-** In this method the iron pipe to be protected is made cathodic by passing impressed current in opposite direction to that of corrosion current.	2
		Iron machinaries:- It can be protected from corrosion by using a) **By Applying metallic coating** of corrosion resistant metals like Cr, Ni etc. **b) By applying organic coatings** like paint enamels lacquers etc**.** **(Note any one method for each)**	2
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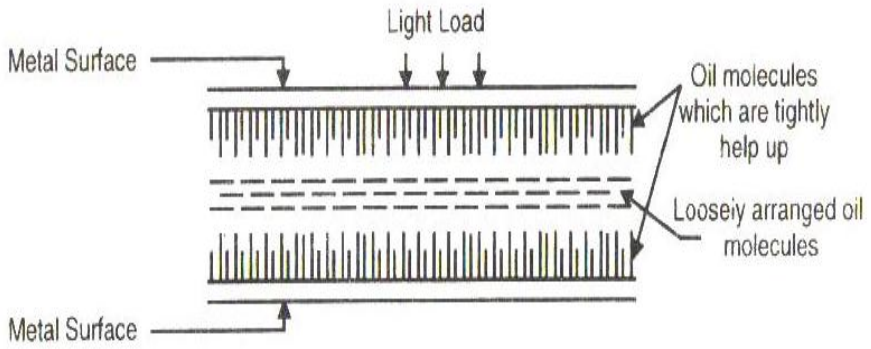
	d)	**Explain fluid film lubrication with diagram**	(4)
		Fluid film lubrication : i)It is carried out by introducing the liquid lubricants in between the moving or sliding surface. The lubricant film covers the irregularities of the sliding or moving surface & forms a thin layer in between them. This thin layer of lubricant avoids metal to metal contact & reduces wear & friction. ii) The resistance to movement of moving parts is only due to the internal resistance between the particles of the lubricant moving over each other. iii) In fluid film lubrication, the lubricant chosen should have the minimum viscosity under working condition & at the same time it should remain in place & separate the surfaces.	2
		Examples: This type of lubrication is provided in case of delicate instrument and light machines like watches, clocks, guns, sewing machines, scientific instrument etc.	1

Q. No.	Sub Q. N.	Answer	Marking Scheme
3			1
	e)	**Give the classification of lubricants. Give one example of each.**	**(4)**
		Classification of lubricants:- i) Solid lubricant ii) Semi solid lubricant iii) Liquid lubricant	1
		i) Solid lubricants: Examples: graphite, molybdenum disulphide, soap, soapstone, wax, talc, chalk, mica, teflon etc.	1 1
		ii) Semi-solid lubricants: Examples: greases and Vaseline.	
		iii) Liquid lubricants: Examples: vegetable and animal oils such as castor, olive, coconut, palm, neem, linseed, hazel nut, tallow, lard, whale, cod-liver oil etc. and fatty acids like oleic acid, stearic acid etc., silicones, blended oils, and mineral oils. **(Any one example of each))**	1

Q. No.	Sub Q. N.	Answer	Marking Scheme
	f)	**Give the selection criteria or lubricant used in I.C. engine and steam engine, sewing machine.**	**(4)**

Machine	Selection criteria	
I.C.engine	Lubricant used in I.C.engines is exposed to high temperature . Hence Lubricant used must have high viscosity index & thermal stability	1
Steam engine	Lubricant used must have 1. Metal wetting property 2. High viscosity 3. Emulsification with water	2
Sewing machine	Lubricant used must be 1. Minimum viscosity under working condition 2. It should form a thin , uniform film between the moving surfaces	1