SUMMER-S19 EXAMINATION

Model Answer

Subject Name: Plant Economics and Energy Management **Subject Code:** 22312

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 five of the Following**	10
	a)	**Types of energy Source** **Primary energy source** is an energy form found in nature that has not been subjected to any conversion or transformation process. The primary energy sources are derived from: the sun, the earth's heat, the wind, water (rivers, lakes, tides, and oceans), fossil fuels - coal, oil, and natural gas, biomass, and radioactive minerals. **Secondary energy source** Secondary energy refers to the more convenient forms of energy which are transformed from other, primary, energy sources through energy conversion processes. Examples are electricity, which is transformed from primary sources such as coal, raw oil, fuel oil, natural gas, wind, sun, streaming water, nuclear power, gasoline etc. **Conventional Energy sources:** These sources are exhaustible after use. e.g Coal, crude oil, Gas **Non-Conventional energy sources:** These sources can renew again and again. e.g Solar, Wind, Biomass, Hydro	1 mark each for any two types

	b)	**Applications of biomass energy** *Wood and wood processing wastes*-burned to heat buildings, to produce process heat in industry, and to generate electricity *Agricultural crops and waste materials*-burned as a fuel or converted to liquid biofuels *Food, yard, and wood waste in garbage*-burned to generate electricity in power plants or converted to biogas in landfills *Animal manure and human sewage*-converted to biogas, which can be burned as a fuel	1/2 mark each for any four
	c)	**Importance of energy conservation: (any 2)** a) To reduce imports of energy and reduce the drain on foreign exchange. b) To improve exports of manufactured goods (either lower process or increased availability helping sales) or of energy, or both. c) To reduce environmental pollution per unit of industrial output - as carbon dioxide, smoke, sulphur dioxide, dust, grit or as coal mine discard for example. d) Thus reducing the costs that pollution incurs either directly as damage, or as needing, special measures to combat it once pollutants are produced. e) Generally to relieve shortage and improve development. f) Advantage in PAT scheme.	1 mark each
	d)	**Types of Energy Audit** • Walkthrough audit • Detailed energy audit	2
	e)	**Total cost** Total cost refers to total expense incurred in reaching a particular level of output, if such total cost is divided by quantity produced average or unit cost is obtained. **Fixed Cost** A cost that remains constant within a given period of time and range of activity in spite of fluctuations in production.	1 1
	f)	**Concept of market:** It is the place where goods or services are sold to the customers. **Types of Markets** 1. Perfect completion	1 ½ mark

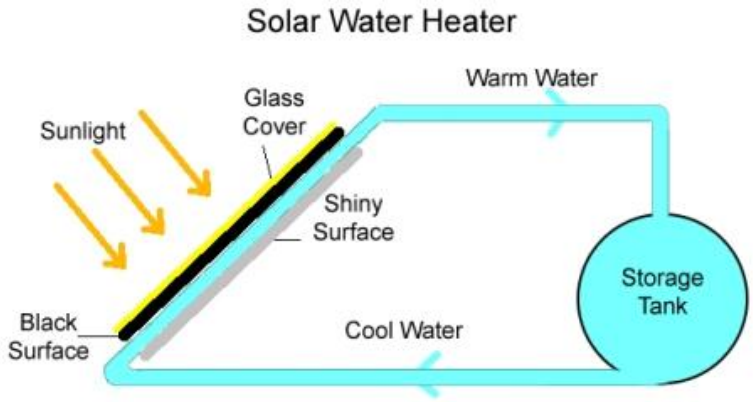
		2. Monopoly 3. Oligopoly 4. Monopolistic Completion 5. Monopsony	each for any 2
	g)	**Simple interest** Simple interest is calculated only on the principal amount, or on that portion of the principal amount that remains. **Compounded interest** Compound interest is the addition of interest to the principal sum of a loan or deposit, or in other words, interest on interest.	1 1
2		**Attempt any three of the following**	**12**
	a)	**Energy Policy in chemical industry** Energy policy is the document used to address issues of energy development/conservation including energy production, distribution and consumption. It the document signed by highest authority in industry which state industries commitment toward energy use and energy conservation. The policy document is displayed everywhere in industry to motivate employees. Chemical industry uses large amount of energy in the form of heat and electricity. Energy saving measures in chemical industry can save large amount of fuel. As per PAT scheme it is mandatory for designated consumers to save energy. Energy policy document prepared by higher authority can give serious impact on other employees and motivate them for implementation of energy conservation projects.	4
	b)	**Concept of solar energy** **Solar thermal** Solar thermal technologies capture the heat energy from the sun and use it for heating and/or the production of electricity. This is different from photovoltaic solar panels, which directly convert the sun's radiation to electricity. There are two main types of solar thermal systems for energy production – active and passive. Active systems require moving parts like fans or pumps to circulate heat-carrying fluids. Passive systems have no mechanical components and rely on design features only to capture heat (e.g.	4 marks for any one type With diagram

greenhouses). The technologies are also grouped by temperature - low, medium or high.

Low-temperature (<100°C) applications typically use solar thermal energy for hot water or space heating. Active systems often consist of a roof-mounted flat plate collector through which liquid circulates. The collector absorbs heat from the sun and the liquid carries it to the desired destination, for example a swimming pool or home heating system. Passive heating systems involve intelligent building design practices, which cut back on the need for heating or cooling systems by better capturing or reflecting solar energy.

Medium-temperature (100-250°C) applications are not common. An example would be a solar oven, which uses a specially-shaped reflector to focus the sun's rays on a central cooking pot. Similar systems could be used for industrial processes, but are not widely used.

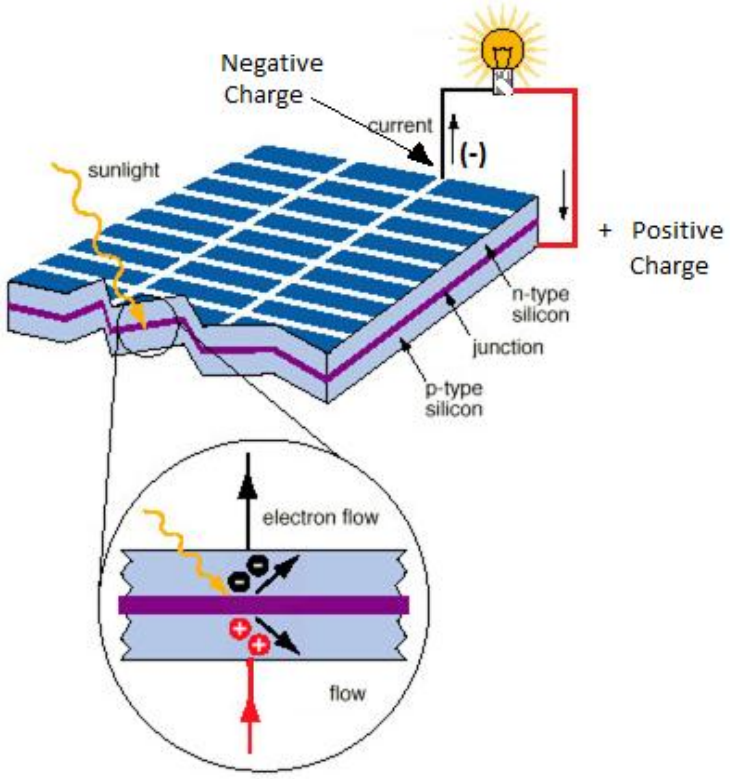
High-temperature (250°C >) solar thermal systems use groups of mirrors to concentrate solar energy onto a central collector. These concentrated solar power (CSP) systems can reach temperatures high enough to produce steam, which then turns a turbine, driving a generator to produce electricity.



Solar Photovoltaic

Our sun is a natural nuclear reactor. It releases tiny packets of energy called photons, which travel the 93 million miles from the sun to Earth in about 8.5 minutes. Every hour, enough photons impact our planet to generate enough solar energy to theoretically satisfy global energy needs for an entire year. Solar cells are used to convert light energy to

		electricity. When photons hit a solar cell, they knock electrons loose from their atoms. If conductors are attached to the positive and negative sides of a cell, it forms an electrical circuit. When electrons flow through such a circuit, they generate electricity. Multiple cells make up a solar panel, and multiple panels (modules) can be wired together to form a solar array. The more panels you can deploy, the more energy you can expect to generate. PV solar panels generate direct current (DC) electricity. With DC electricity, electrons flow in one direction around a circuit. This example shows a battery powering a light bulb. The electrons move from the negative side of the battery, through the lamp, and return to the positive side of the battery. With AC (alternating current) electricity, electrons are pushed and pulled, periodically reversing direction, much like the cylinder of a car's engine. Generators create AC electricity when a coil of wire is spun next to a magnet. Many different energy sources can "turn the handle" of this generator, such as gas or diesel fuel, hydroelectricity, nuclear, coal, wind, or solar.	

			
	c)	**Energy Conservation methods in industry** **1. Improved fuel storage, handling and preparation practices** Energy conservation can be done by avoiding oil spillage, preventing oil leakage, draining water from storage tanks, cleaning strainers and filters, maintaining fuel oil at higher temperature in storage tank, and maintaining correct preheat temperature, 2. **Maintaining proper insulation of steam lines and equipment** Properly designed insulation and refractories for industrial systems can mean big energy and cost savings for manufacturing companies. All insulated surfaces lose some heat. The heat loss depends on a number of factors, such as the heating system or heat source temperature, selection and thickness of insulation used, and exposure of insulated surfaces to ambient conditions. Heating systems may lose 2 percent to 5 percent of the total heat input for the heating system through insulated surfaces. It is not feasible or always advisable to eliminate all insulation-related heat loss, but it is possible to reduce these losses by 10 percent to 25 percent. To achieve this, plant personnel must:	2 marks each for any two

review process requirements;

- know available and applicable insulation materials;
- select materials to meet the process requirements;
- properly design, install and precondition insulation systems during start-up;
- properly operate the equipment to avoid damage to the insulation; and,
- Perform periodic maintenance, repairs and replacement of the insulation.

3.Power factor improvement

Power Factor Correction is a device that is installed on an electrical system to improve the overall electrical efficiency known as power factor of an electrical supply that operates machines or motors.

All motors which can come in the form of a machine, conveyor, mixer, compressor, HVAC, refrigeration, elevator or escalator etc all have an efficiency rating known as power factor. The ultimate desired power factor is 1.00pf (100% efficient) although most motors operate at a much lower efficiency or power factor which when the effects are accumulated on an electrical supply, the results can be as low at 0.50 power factor and commonly around 0.80 power factor on a typical uncorrected industrial electrical supply.

4. Fuel substitution

Substituting existing fossil fuel with more efficient and less cost/less polluting fuel such as natural gas, biogas and locally available agro-residues.

Energy is an important input in the production. There are two ways to reduce energy dependency; energy conservation and substitution.

Fuel substitution has taken place in all the major sectors of the Indian economy. Kerosene and Liquefied Petroleum Gas (LPG) have substituted soft coke in residential use.

Few examples of fuel substitution

- Natural gas is increasingly the fuel of choice as fuel and feedstock in the fertilizer, petro chemicals, power and sponge iron industries.
- Replacement of coal by coconut shells, rice husk etc.
- Replacement of LDO by LSHS

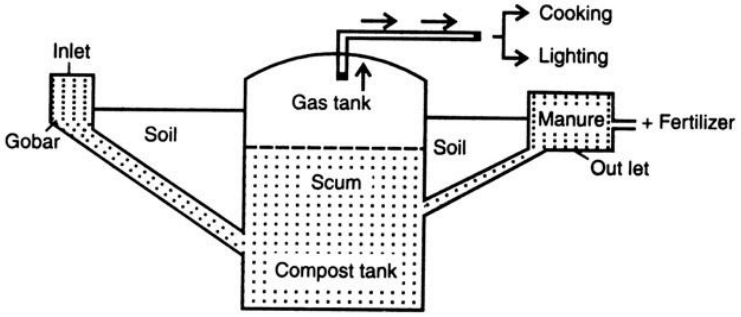
Few examples of energy substitution

		• Replacement of electric heaters by steam heaters • Replacement of steam based hotwater by solar systems	
	d)	**I.Advantages of payback period** **Simple to use and easy to understand** This is among the most significant advantages of the payback period. The method needs very few inputs and is relatively easier to calculate than other capital budgeting methods. All that you need to calculate the payback period is the project's initial cost and annual cash flows. Though other methods also use the same inputs, they need more assumptions as well. For instance, the cost of capital, which other methods use, requires managers to make several assumptions. **Quick solution** Since the payback period is easy to calculate and need fewer inputs, managers are quickly able to calculate the payback period of the projects. This helps the managers to make quick decisions, something that is very important for the companies with limited resources. **Preference for liquidity** Payback period is crucial information that no other capital budgeting method reveals. Usually, a project with a shorter payback period also has a lower risk. Such information is extremely crucial for the small businesses with limited resources. Small businesses need to quickly recover their cost so as to reinvest it in other opportunities. **Useful in case of uncertainty** The payback method is very useful in the industries that are uncertain or witness rapid technological changes. Such uncertainty makes it difficult to project the future annual cash inflows. Thus, using and undertaking projects with short PBP helps in reducing the chances of a loss through obsolescence. **II. Disadvantages of payback period** **Not all cash flows covered** The payback method considers the cash flows only till the time the initial investment is recovered. It fails to consider the cash flows that come in the subsequent years. Such a	1 mark each for any two advantage and 1 marks each for any two disadvantage

		limited view of the cash flows might force you to overlook a project that could generate lucrative cash flows in their later years. **Not realistic** The payback method is so simple that it does not consider normal business scenarios. Usually, capital investments are not just one-time investments. Rather such projects need further investments in the following years as well. Also, projects usually have irregular cash inflows. **Ignores profitability** A project with a shorter payback period is no guarantee that it will be profitable. What if the cash flows from the project stop at the payback period, or reduces after the payback period. In both the cases, the project would become unviable after the payback period ends.	
3		**Attempt any three of the following**	**12**
	a)	**Fixed Roof Biogas Plant** **Construction** It consits of inlet tank, digester and outlet tank. Sluury is prepeared in inlet tank. Mass is digeated in digester. Gas is collected at the top dome. Digested mass comes our from outlet tank. Gas is taken out by outlet pipe from top. **Working** • The feed material is mixed with water in the influent collecting tank The fermentation slurry flows through the inlet into the digester. • The bacteria from the fermentation slurry are intended to produce biogas in the digester. • The process of anaerobic digestion occurs in a sequence of stages involving distinct types of bacteria. • Hydrolytic and fermentative bacteria first break down the carbohydrates, proteins and fats present in biomass feedstock into fatty acids, alcohol, carbon	4 marks for any one type

dioxide, hydrogen, ammonia and sulfides.

- This stage is called "hydrolysis" (or "liquefaction").
- Next, acetogenic (acid-forming) bacteria further digest the products of hydrolysis into acetic acid, hydrogen and carbon dioxide.
- Methanogenic (methane-forming) bacteria then convert these products into biogas.
- The combustion of digester gas can supply useful energy in the form of hot air, hot water or steam.



OR

Floating Roof Biogas Plant

Construction

It consits of inlet tank, digester and outlet tank. The floating gas holder type bio gas plant consists of a dome shaped gas holder made of steel for collecting bio gas. The dome shaped gas holder is not fixed but is moveable and floats over the slurry present in the digester tank. Due to this reason, this biogas plant is called floating gas holder type biogas plant.Digested mass comes our from outlet tank. Gas is taken out by outlet pipe from top.

Working

- The feed material is mixed with water in the influent collecting tank The fermentation slurry flows through the inlet into the digester.
- The bacteria from the fermentation slurry are intended to produce biogas in the

digester.

- The process of anaerobic digestion occurs in a sequence of stages involving distinct types of bacteria.
- Hydrolytic and fermentative bacteria first break down the carbohydrates, proteins and fats present in biomass feedstock into fatty acids, alcohol, carbon dioxide, hydrogen, ammonia and sulfides.
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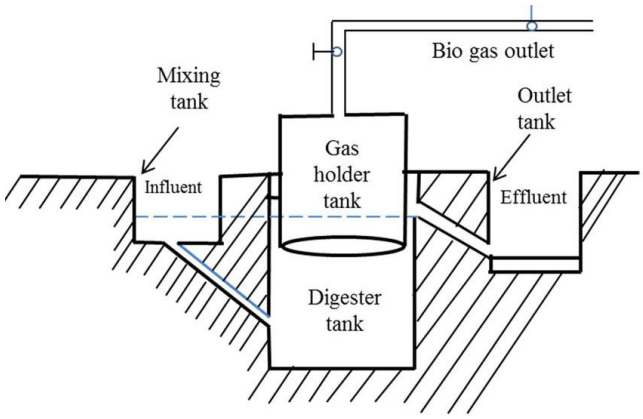

b) **Depreciation** — 1

Definition: The monetary value of an asset decreases over time due to use, wear and tear or obsolescence. This decrease is measured as depreciation.

Depreciation, i.e. a decrease in an asset's value, may be caused by a number of other factors as well such as unfavorable market conditions, etc. Machinery, equipment, currency are some examples of assets that are likely to depreciate over a specific period of time. Opposite of depreciation is appreciation which is increase in the value of an asset over a period of time. — 2

		Accounting estimates the decrease in value using the information regarding the useful life of the asset. This is useful for estimation of property value for taxation purposes like property tax etc. For such assets like real estate, market and economic conditions are likely to be crucial such as in cases of economic downturn. **Factors affecting depreciation** 1.Cost Of Assets 2. Estimated Scrap Value 3. Estimated Useful Life 4. Legal Provisions	1 mark for any two factors
	c)	**Responsibilities and Duties of Energy Manager** **Responsibilities** • Prepare an annual activity plan and present to management concerning financially attractive investments to reduce energy costs • Establish an energy conservation cell within the firm with management's consent about the mandate and task of the cell. • Initiate activities to improve monitoring and process control to reduce energy costs. • Analyze equipment performance with respect to energy efficiency • Ensure proper functioning and calibration of instrumentation required to assess level of energy consumption directly or indirectly. • Prepare information material and conduct internal workshops about the topic for other staff. • Improve disaggregating of energy consumption data down to shop level or profit center of a firm. • Establish a methodology how to accurately calculate the specific energy consumption of various products/services or activity of the firm. • Develop and manage training programme for energy efficiency at operating levels. • Co-ordinate nomination of management personnel to external programs. • Create knowledge bank on sectoral, national and inter-national development on energy efficiency technology and management system and information denomination • Develop integrated system of energy efficiency and environmental up gradation.	1 each each for any two

<table>
<tr><td></td><td></td><td>• Co-ordinate implementation of energy audit/efficiency improvement projects through external agencies.
• Establish and/or participate in information exchange with other energy managers of the same sector through association
Duties
• Report to BEE and State level Designated Agency once a year the information with regard to the energy consumed and action taken on the recommendation of the accredited energy auditor, as per BEE Format.
• Establish an improved data recording, collection and analysis system to keep track of energy consumption.
• Provide support to Accredited Energy Audit Firm retained by the company for the conduct of energy audit
• Provide information to BEE as demanded in the Act, and with respect to the tasks given by a mandate, and the job description.
• Prepare a scheme for efficient use of energy and its conservation and implement such scheme keeping in view of the economic stability of the investment in such form and manner as may be provided in the regulations of the Energy Conservation Act.</td><td>1 each each for any two</td></tr>
<tr><td></td><td>d)</td><td>Difference between solid and liquid fuel
<table>
<tr><th>Solid Fuel</th><th>Liquid Fuel</th></tr>
<tr><td>It is available and stored in solid form</td><td>It is available and stored in liquid form</td></tr>
<tr><td>Content more amount of ash.</td><td>Ash content is very minute.</td></tr>
<tr><td>Content more amount of sulphur.</td><td>Content less amount of sulphur than solid fuel.</td></tr>
<tr><td>Excess air required for burning is more among all type of fuels.</td><td>Excess air required is less than solid fuel.</td></tr>
<tr><td>Calorific value per unit mass is less among</td><td>Calorific value per unit mass is more</td></tr>
</table></td><td>1 each each for any four points</td></tr>
</table>

		all types of fuels.	than solid fuel
		e.g. Coal, Wood, Petcoke, Agri waste etc.	e.g. Diesel, petrol, fuel oil, ethanol, biodiesel etc.

4		**Attempt any three of the following**	**12**
	a)	**Gross calorific value (GCV)** The total amount of heat released when a fuel is burned. When fossil fuels are burned, the carbon and hydrogen in these fuels combine with oxygen in the air to produce carbon dioxide and water. Some of the energy released in burning goes into transforming the water into steam and is usually lost. The amount of heat spent in transforming the water into steam is counted as part of gross calorific value but is not counted as part of net calorific value. Gross calorific value (GCV) assumes that the water of combustion is entirely condensed. The heat contained in this water is recovered. Gross calorific value is also referred to as the higher heating value. The gross calorific value indicates how much energy can be released during the complete combustion of a given amount of fuel: It is comprised of the net calorific value plus the energy contained in the exhaust gases and in the water vapor produced during combustion. Therefore, the gross calorific value is always higher than the net calorific value. **Net Calorific Value** Net Calorific Value (NCV) also known as lower heating value (LHV) or lower calorific value (LCV) is determined by the subtracting the heat of vaporization of the water vapour from the higher heating value.This treats any H_2O formed as a vapor. Natural gas prices are decided on the basis of GCV and NCV. The amount of usable heat energy released when a fuel is burned under conditions similar to those in which it is normally used. When fossil fuels are burned, the carbon and hydrogen in these fuels combine with oxygen in the air to produce carbon dioxide and water. Some of the energy released in burning goes into transforming the water into steam and is usually lost. The amount of heat spent in transforming the water into steam is not	2 2

		counted as part of net heat content. Net heat content is also referred to as the lower heating value. Net calorific value = gross calorific value – condensation heat	
	b)	**Benefits of solar energy** • Renewable • Inexhaustible • Non-polluting • Avoids global warming • Reduces use of fossil fuels • Reduces energy imports • Generates local wealth and jobs • Contributes to sustainable development • It is modular and very versatile, adaptable to different situations • Can be applied alike for large-scale electricity generation and on a small scale in areas isolated from the network **Benefits of biomass energy** • It's a renewable form of energy • It's carbon neutral • Widely available • It's cheaper compared to fossil fuels • Minimizes overdependence on traditional electricity • Reduces amount of waste in landfills • Can be Used to Create Different Products	1 mark each for any two 1 mark each for any two
	c)	**Environmental benefits of Wind Energy** **1. Renewable & Sustainable** Wind energy itself is both renewable and sustainable. The wind will never run out, unlike the earth's fossil fuel reserves (such as coal, oil and gas), making it the ideal energy source for a sustainable power supply.	2 marks for any 2

		2. Environmentally Friendly Wind turbines produce no greenhouse gases such as carbon dioxide (CO_2) or methane (CH_4) which are both known to contribute towards global warming. **3. Reduces Fossil Fuel Consumption** Generating electricity from wind energy reduces the need to burn fossil fuel alternatives such as coal, oil and gas. **4. Small Footprint** Wind turbines have a relatively small land footprint. Although they can tower high above the ground, the impact on the land at the base is minimal. The area around the base of a wind turbine can often be used for other purposes such as agriculture**.** **Problems of wind energy** **1. Threat to Wildlife** It's widely reported that wind turbines pose a threat to wildlife, primarily birds and bats. It is however believed that wind turbines pose less of a threat to wildlife than other manmade structures such as cell phone masts and radio towers. **2. Noise Pollution** One of the most popular disadvantages of wind turbines is the noise pollution that they generate. A single wind turbine can be heard from hundreds of meters away. **3. Visual Pollution** Another widely reported disadvantage of wind turbines is visual pollution. Although many people actually like the look of wind turbines, others do not and see them as a blot on the landscape	2 marks for any 2
	d)	**Types of Energy Audit** • Walkthrough audit • Detailed energy audit **Walkthrough Energy Audit** The preliminary audit (alternatively called a simple audit, screening audit or walk-through audit) is the simplest and quickest type of audit. It involves minimal interviews with site-operating personnel, a brief review of facility utility bills and other operating data, and a	1 3

<table>
<tr><td></td><td></td><td>walk-through of the facility to become familiar with the building operation and to identify any glaring areas of energy waste or inefficiency. Typically, only major problem areas will be covered during this type of audit. Corrective measures are briefly described, and quick estimates of implementation cost, potential operating cost savings, and simple payback periods are provided. A list of energy conservation measures (ECMs, or energy conservation opportunities, ECOs) requiring further consideration is also provided. This level of detail, while not sufficient for reaching a final decision on implementing proposed measure, is adequate to prioritize energy-efficiency projects and to determine the need for a more detailed audit.</td><td></td></tr>
<tr><td></td><td>e)</td><td>Difference between commercial and non commercial energy
<table>
<tr><th>Commercial energy</th><th>Non Commercial energy</th></tr>
<tr><td>It is available at define price in the market</td><td>Not available at define price.</td></tr>
<tr><td>These are mainly fossil fuels</td><td>These are mainly agricultural waste, forest waste</td></tr>
<tr><td>It is traded globally</td><td>It available locally.</td></tr>
<tr><td>e.g. Petroleum fuels , coal</td><td>e.g. dry wood, dry cow dung, saw dust, rice husk etc.</td></tr>
</table></td><td>1 mark each</td></tr>
<tr><td>5</td><td></td><td>Attempt any two of the following</td><td>12</td></tr>
<tr><td></td><td>a)</td><td>Income tax
An income tax is a tax imposed on individuals or entities (taxpayers) that varies with respective income or profits (taxable income). Income tax generally is computed as the product of a tax rate times taxable income. Taxation rates may vary by type or characteristics of the taxpayer.
The tax rate may increase as taxable income increases (referred to as graduated or progressive rates). The tax imposed on companies is usually known as corporate tax and is levied at a flat rate. However, individuals are taxed at various rates according to the slab in which they fall. Further, the partnership firms are also taxed at flat rate. Most jurisdictions exempt locally organized charitable organizations from tax. Capital gains may be taxed at different rates than other income. Credits of various sorts may be</td><td>2 marks for each for 3 types</td></tr>
</table>

allowed that reduce tax. Some jurisdictions impose the higher of an income tax or a tax on an alternative base or measure of income.

Taxable income of taxpayers resident in the jurisdiction is generally total income less income producing expenses and other deductions. Generally, only net gain from sale of property, including goods held for sale, is included in income. Income of a corporation's shareholders usually includes distributions of profits from the corporation. Deductions typically include all income producing or business expenses including an allowance for recovery of costs of business assets. Many jurisdictions allow notional deductions for individuals, and may allow deduction of some personal expenses. Most jurisdictions either do not tax income earned outside the jurisdiction or allow a credit for taxes paid to other jurisdictions on such income. Nonresidents are taxed only on certain types of income from sources within the jurisdictions, with few exceptions.

Excise tax

An **excise** or **excise tax** is any duty on manufactured goods which is levied at the moment of manufacture, rather than at sale. Excises are often associated with customs duties (which are levied on pre-existing goods when they cross a designated border in a specific direction); customs are levied on goods which come into existence – as taxable items – at the *border*, while excise is levied on goods which came into existence *inland*.

Although sometimes referred to as a *tax*, excise is specifically a *duty*; *tax* is technically a levy on an individual (or more accurately, the assessment of what that amount might be), while duty is a levy on particular goods. An excise is considered an indirect tax, meaning that the producer or seller who pays the levy to the government is expected to try to recover their loss by raising the price paid by the eventual buyer of the goods. Excises are typically imposed in addition to an indirect tax such as a sales tax or value-added tax (VAT).

GST

Goods and Services Tax (GST) is an indirect tax (or consumption tax) imposed in India on the supply of goods and services. It is a comprehensive multistage, destination based tax. Comprehensive because it has subsumed almost all the indirect taxes except few.

		Multi-Staged as it is imposed at every step in the production process, but is meant to be refunded to all parties in the various stages of production other than the final consumer. And destination based tax, as it is collected from point of consumption and not point of origin like previous taxes. Goods and services are divided into five tax slabs for collection of tax - 0%, 5%, 12%, 18% and 28%. However, Petroleum products, alcoholic drinks, electricity, are not taxed under GST and instead are taxed separately by the individual state governments, as per the previous tax regime.[citation needed] There is a special rate of 0.25% on rough precious and semi-precious stones and 3% on gold. In addition a cess of 22% or other rates on top of 28% GST applies on few items like aerated drinks, luxury cars and tobacco products. Pre-GST, the statutory tax rate for most goods was about 26.5%, Post-GST, most goods are expected to be in the 18% tax range The tax came into effect from July 1, 2017 through the implementation of One Hundred and First Amendment of the Constitution of India by the Indian government. The tax replaced existing multiple flowing taxes levied by the central and state governments. The tax rates, rules and regulations are governed by the GST Council which consists of the finance ministers of centre and all the states. GST is meant to replace a slew of indirect taxes with a federated tax and is therefore expected to reshape the country's 2.4 trillion dollar economy, but not without criticism. Trucks' travel time in interstate movement dropped by 20%, because of no interstate check posts.	
	b)	**Application of** **i) Coal :** In power plant, Cement industry, Coal gasification products **ii) Petroleum products :** Transport fuels, industrial boiler fuels, feed stock for petrochemicals **iii) Natural gas :** In power plant, as transportation fuel, as Feed stock for fertilizer industry, as a fuel in furnaces, as cooking fuel, as a source of hydrogen	2 2 2
	c)	**Balance Sheet** In financial accounting, a balance sheet or statement of financial position is a summary of the financial balances of an individual or organization, whether it be a sole proprietorship, a business partnership, a corporation, private limited company or other organization such	3

as Government or not-for-profit entity. Assets, liabilities and ownership equity are listed as of a specific date, such as the end of its financial year. A balance sheet is often described as a "snapshot of a company's financial condition". Of the four basic financial statements, the balance sheet is the only statement which applies to a single point in time of a business' calendar year.

A standard company balance sheet has two sides: assets, on the left and financing, which itself have two parts, liabilities and ownership equity, on the right. The main categories of assets are usually listed first and typically in order of liquidity. Assets are followed by the liabilities. The difference between the assets and the liabilities is known as equity or the net assets or the net worth or capital of the company and according to the accounting equation, net worth must equal assets minus liabilities.

SAMPLE

BALANCE SHEET

ASSETS		LIABILITIES & EQUITY	
Current Assets		***Liabilities***	
		Current Liabilities	
Checking Account	5,000	Accounts Payable	12,000
Savings Account	1,000	Line of Credit	20,000
Petty Cash	500	Payroll Liabilities	7,000
Accounts Receivable	22,000		
Inventory	15,000		
Prepaid Insurance	6,000		
Total Current Assets:	49,500	***Total Current Liabilities:***	39,000
Noncurrent Assets		***Noncurrent Liabilities***	
Accumulated Depreciation	-4,500	Long-term Debt (loan)	48,000
Computer	7,000	***Total Liabilities:***	87,000
Building	65,000	***Equity***	
Land	60,000	Owner's Capital	35,000
		Retained Earnings	55,000
Total Noncurrent Assets:	127,000	***Total Equity:***	90,000
Total Assets:	177,000	***Total Liabilities & Equity:***	177,000

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6		**Attempt any two of the following**	**12**

	a)	**The Law of Demand** The law of demand states that, if all other factors remain equal, the higher the price of a good, the less people will demand that good. In other words, the higher the price, the lower the quantity demanded. The amount of a good that buyers purchase at a higher price is less because as the price of a good goes up, so does the opportunity cost of buying that good. As a result, people will naturally avoid buying a product that will force them to forgo the consumption of something else they value more. **The Law of Supply** Like the law of demand, the law of supply demonstrates the quantities that will be sold at a certain price. But unlike the law of demand, the supply relationship shows an upward slope. This means that the higher the price, the higher the quantity supplied. Producers supply more at a higher price because selling a higher quantity at a higher price increases revenue.A, B and C are points on the supply curve. Each point on the curve reflects a direct correlation between quantity supplied (Q) and price (P). At point B, the quantity supplied will be Q2 and the price will be P2, and so on. **Methods for measurement** • Percentage Method • Total Expenditure Method • Graphic Method **Percentage Method** Percentage method or proportionate method is the commonly used method of measuring price elasticity of supply. According to this method, elasticity is measured in terms of rate of percentage change in supplied quantity to percentage change in price. Under this method, price elasticity of supply can be measured $PES = \frac{\%\text{ change in quantity supplied}}{\%\text{ change in price}}$	1mark each for law of demand and supply 2 mark each for any two

Where,

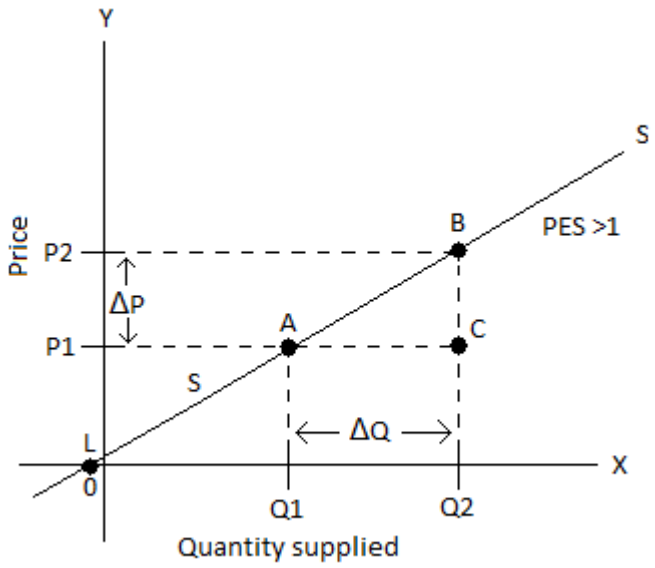
$$\% \text{ change in quantity supplied} = \frac{\text{new quantiy (Q2) - initial quantity (Q1)}}{\text{initial quantity (Q1)}} \text{ X100}$$

$$\% \text{ change in price} = \frac{\text{new price (P2) - initial price (P1)}}{\text{initial price (P1)}} \text{ X100}$$

Geometric Method

Geometric method is the technique of measuring price elasticity of supply at any given point on the supply curve. This method is also known as arc method or point method.

Given below is an illustration of measuring price elasticity of supply from a supply curve.



From percentage method, we have known that

		$PES = \frac{\Delta Q}{\Delta P} X \frac{P}{Q}$ ..... (i) $= \frac{Q1Q2}{P1P2} X \frac{OP1}{OQ1}$ $= \frac{AC}{BC} X \frac{AQ1}{OQ1}$ ..... (ii) [Since, Q1Q2 = AC, P1P2 = BC & OP1 = AQ1] **Total Expenditure Method:** According to this method, elasticity of demand can be measured by considering the change in price and the subsequent change in the total quantity of goods purchased and the total amount of money spent on it. Total Outlay = Price X Quantity Demanded **There are three possibilities:** (i) If with a fall in price (demand increases) the total expenditure increases or with a rise in price (demand falls), the total expenditure falls, in that case the elasticity of demand is greater than one i.e. ED > 1. (ii) If with a rise or fall in the price (demand falls or rises respectively), the total expenditure remains the same, the demand will be unitary elastic or ED = 1. (iii) If with a fall in price (Demand rises), the total expenditure also falls, and with a rise in price (Demand falls) the total expenditure also rises, the demand is said to be less classic or elasticity of demand is less than one (ED < 1).	
	b)	**Methods of calculation of depreciation:** 1. Straight line method 2. Sum of years digit method 3. Sinking Fund method 4. Annuity method 5. Witten down method **Straight line depreciation** In straight line depreciation method, cost of a fixed asset is reduced uniformly over the	3

		useful life of the asset. Since depreciation expense charged to income statement in each period is the same, the carrying amount of the asset on balance sheet declines in a straight line. Due to its simplicity, straight line method of depreciation is the most commonly used depreciation method. Accounting principles require companies to depreciate its fixed assets using method that best reflects the pattern in which the assets are being used. While the straight-line method is appropriate in many situations, some fixed assets lose more value in initial years. In such situations other depreciation methods are more appropriate. Straight line depreciation method can be calculated using following formula: $$\textbf{\textit{Depreciation per annum}} = (\textbf{\textit{Cost of the Asset}} - \textbf{\textit{Salvage Cost}}) \times \textbf{\textit{Depreciation Rate}}$$ OR **Sinking fund (SF) depreciation method:-** In this method it is assumed that money is deposited in a sinking fund over the useful life that will enable to replace the asset at the end of its useful life. For this purpose, a fixed amount is set aside every year from the revenue generated and this fixed sum is considered to earn interest at an interest rate compounded annually over the useful life of the asset, so that the total amount accumulated at the end of useful life is equal to the total depreciation amount i.e. initial cost less salvage value of the asset. Thus the annual depreciation in any year has two components. The first component is the fixed sum that is deposited into the sinking fund and the second component is the interest earned on the amount accumulated in sinking fund till the beginning of that year. For this purpose, first the uniform depreciation amount (i.e. fixed amount deposited in sinking fund) at the end of each year is calculated by multiplying the total depreciation amount (i.e. initial cost less salvage value) over the useful life by sinking fund factor. After that the interest earned on the accumulated amount is calculated. The calculations are shown below. The first component of depreciation i.e. uniform depreciation amount 'A' at the end of each year is given by; $$A = (P - SV) \times (A/F, i, n) = (P - SV) \times \frac{i}{(1+i)^n - 1}$$	3 marks for any one method

Where i = interest rate per year

Depreciation amount for 1st year is equal to only 'A' as this is the amount (set aside every year from the revenue generated) to be deposited in sinking fund at the end of 1st year and hence there is no interest accumulated on this amount.

OR

Sum of the Years' Digits Method of Depreciation

Sum of the years' digits method of depreciation is one of the accelerated depreciation techniques which are based on the assumption that assets are generally more productive when they are new and their productivity decreases as they become old. The formula to calculate depreciation under SYD method is:

SYD Depreciation =

$$\text{Depreciable Base} \times \frac{\text{Remaining Useful Life}}{\text{Sum of the Years' Digits}}$$

In the above formula, depreciable base is the difference between cost and salvage value of the asset and sum of the years' digits is the sum of the series:

1, 2, 3, ... , n ; where n is the useful life of the asset in years.

Sum of the years' digits can be calculated more conveniently using the following formula:

$$\text{Sum of the Years' Digits} = \frac{n(n+1)}{2}$$

Sum of the years' digits method can also be applied on monthly basis, in which case the above formula to calculate the sum of the years' digits becomes much useful.

OR

Annuity Method:

In Annuity method, we will calculate a fixed amount of depreciation on the original cost of an asset but also calculate interest on the invested amount of capital on the purchase of this asset with help of annuity table.

We will debit an asset account with the amount of interest earn at a fixed rate on the

		balance of an asset at the reduced value and charged fixed amount or rate of depreciation every year for the estimated life of an asset. This method is suitable for those assets on which lager amount was invested and have the definite period life.	
	c)	**Factors affecting cost estimation** **1) Labor Wage Rates:** Labor wages varies place to place. So, local wage rate should be considered in calculation. If the project has to be started after several months of estimating the project cost, the probable variation in wage rates has to be considered in the calculation. **2) Inflation Factor:** A construction project can continue for years before completion. During the construction period, the cost of materials, tools, labors, equipment etc. may vary from time to time. These variations in the prices should be considered during cost estimation process. **3) Project Schedule:** Duration of construction project is affects the cost. Increase in project duration can increase the construction project cost due to increase in indirect costs, while reduction in construction cost also increases the project cost due to increase in direct costs. Therefore, construction project schedules also need to be considered during project cost estimation. **4) Quality of Plans & Specifications:** A good quality construction plans and specifications reduce the construction time by proper execution at site without delay. Any vague wording or poorly drawn plan not only causes confusion, but places doubt in the contractor's mind which generally results in a higher construction cost. **5) Reputation of Engineer:** Smooth running of construction is vital for project to complete in time. The cost of projects will be higher with sound construction professional reputation. If a contractor is comfortable working with a particular engineer, or engineering firm, the project runs smoother and therefore is more cost-effective. **6) Regulatory Requirements:** Approvals from regulatory agencies can sometimes be costly. These costs also need to be considered during cost estimate. **7) Insurance Requirements:** Cost estimation for construction projects should also need	3 marks for any 3 factors and 3 marks for their effects

		to consider costs of insurance for various tools, equipment, construction workers etc. General insurance requirements, such as performance bond, payment bond and contractors general liability are normal costs of construction projects. In some special projects, there can be additional requirements which may have additional costs. **8) Size and Type of Project:** For a large project, there can be high demand for workforce. For such requirements, local workmen may not be sufficient and workmen from different regions need be called. These may incur extra costs such projects and also for the type of construction project where specialized workforce is required. **9) Location: When** a location of construction project is far away from available resources, it increases the project cost **10) Contingency:** It is always advisable to add at least 10% contingency towards the total project costs for unforeseen costs and inflation.	