WINTER – 2019 EXAMINATION

Model Answer

Subject Name: Energy and Biomedical Waste Management **Subject Code: 22549**

Important Instructions to examiners:

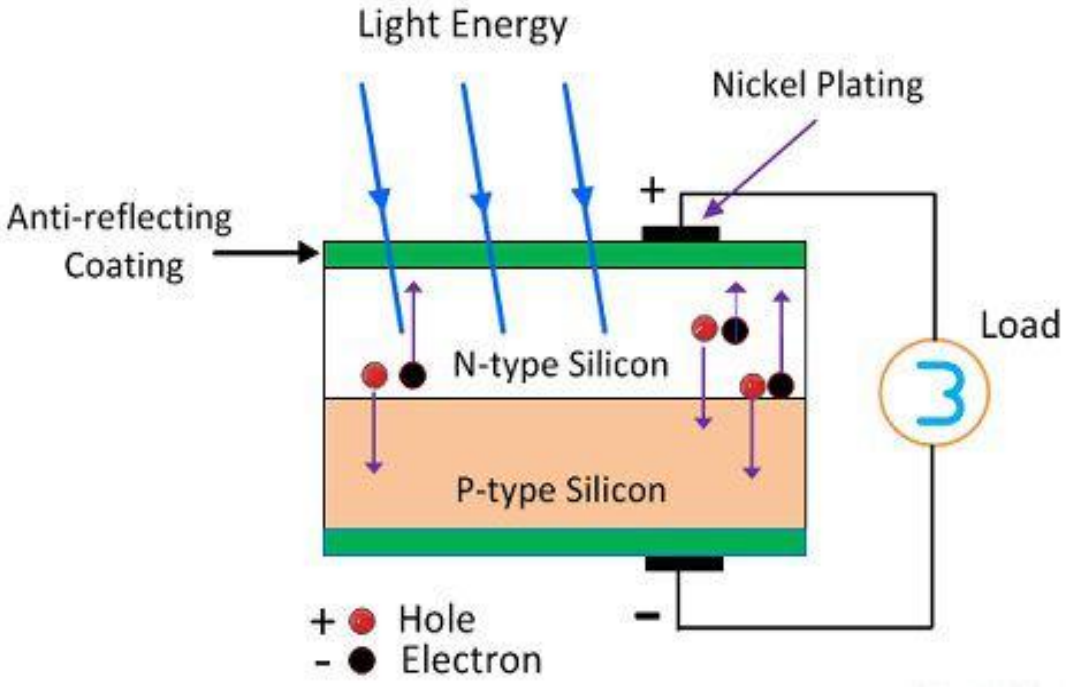
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 judgment 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 M**
	a	**List various non-conventional energy resources.** **Ans:** **Non-conventional energy resources:** 1. Wind 2. Tides 3. Solar 4. Biomass	**02 M**
	b	**Write advantages of conventional energy sources.** **Ans:** **Advantages of conventional energy sources:** 1. Conventional energy sources are proven technologies which can provide energy regardless of weather conditions. 2. Fully developed technology is available to harness this energy. 3. Financial costs are much lower than the alternative energy sources. 4. They can be easily transported to any place. 5. Ideal for small applications.	**02 M**
	c	**State applications of solar energy.** **Ans:** **Applications of solar energy:** 1. Solar water heating 2. Solar heating of buildings 3. Solar distillation and solar pumping. 4. Solar drying of agricultural and animal products 5. Solar furnaces 6. Solar cooking 7. Solar electric power generation 8. Solar thermal power production and solar green houses.	**02 M**

	d	**State the impact of biomedical waste on health.** **Ans:** **Impact of biomedical waste on health:** 1. Biomedical waste contains potentially harmful microorganisms which can infect hospitalized patients, health workers and the general public. 2. In health care workers three infections are most commonly transmitted: hepatitis B virus, hepatitis C virus and human immunodeficiency virus. 3. Other risks associated with waste and by-products include radiation burns, sharp-inflicted injuries, poisoning and pollution through the release of pharmaceutical products, poisoning and pollution through waste water and by toxic elements and compounds such as mercury and dioxins that are released during incineration.	**02 M**
	e	**List sources of biomedical waste.** **Ans:** **Sources of biomedical waste:** 1. Human anatomical waste like tissues, organs and body parts. 2. Animal wastes generated during research from veterinary hospitals. 3. Microbiology and biotechnology wastes. 4. Waste sharps like hypodermic needles, syringes, scalpels and broken glass. 5. Discarded medicines and cytotoxic drugs. 6. Soiled waste such as dressing, bandages, plaster casts, material contaminated with blood, tubes and catheters. 7. Liquid waste from any of the infected areas. 8. Incineration ash. 9. Other chemical wastes.	**02 M**
	f	**State the meaning and significance of Autoclaving.** **Ans:** **Meaning of Autoclaving:** It is a sterilization method that uses high-pressure steam. **Significance of Autoclaving:** Autoclaves provide a physical method for disinfection and sterilization. They work with a combination of steam, pressure and time. They are used to decontaminate certain biological waste and sterilize media, instruments and lab ware. Regulated medical waste that might contain bacteria, viruses and other biological material are recommended to be inactivated by autoclaving before disposal.	**01 M** **01 M**
	g	**List segregation categories of waste.** **Ans:**	**02 M**

Colour Coding	Type of Containers	Waste Category	Treatment options
Yellow	Plastic bag	1,2,3,6	Incineration/deep burial
Red	Disinfected Container/ Plastic bag	3,6,7	Autoclaving/Microwaving/Chemical Treatment
Blue/ White translucent	Plastic bag/puncture proof container	4,7	Autoclaving/ Microwaving/ Chemical Treatment and destruction/shredding
Black	Plastic bag	5,9,10 (Solid)	Disposal in secured landfill.

Table: Segregation categories of waste

2.		**Attempt any THREE of the following:**	**12 M**
	a	**Write disadvantages of non-conventional energy sources.** **Ans:** **Disadvantages of non-conventional energy sources:** 1. Inconsistent, Unreliable Supply. 2. Pollution. 3. Harmful to Wildlife and Surrounding Environment. 4. High Cost. 5. Not Every Non-Conventional Energy Source Is Commercially Viable. 6. Location-Specificity Means Lower Chances of Universality. 7. Low Efficiency Levels.	**04 M**
	b	**Explain PV cell using suitable diagram.** **Ans:**  **Fig: A photovoltaic (PV) cell** A photovoltaic (PV) cell is an energy harvesting technology. Solar cells, also called photovoltaic (PV) cells, convert sunlight directly into electricity. PV gets its name from the process of converting light (photons) to electricity (voltage), which is called the PV effect. The semiconductor materials like arsenide, indium, cadmium, silicon, selenium and gallium are used for making the PV cells. Mostly silicon and selenium are used for making the cell. Consider the figure above shows the constructions of the silicon photovoltaic cell. The upper surface of the cell is made of the thin layer of the p-type material so that the light can easily enter into the material. The metal rings are placed around p-type and n-type material which acts as their positive and negative output terminals respectively. The output voltage and current obtained from the single unit of the cell is very less. The light incident on the semiconductor material may be passing or reflected through it. When the semiconductor material absorbs light, the electrons of the material starts emitting. This happens because the light consists small energize particles called photons. When the electrons absorb the photons, they become energized and start moving into the material. Because of the effect of an electric field, the particle moves only in the one direction and develops current.	**02 M** **02 M**

	c	**State the features of Electricity Act 2003.** **Ans:** **Features of Electricity Act-2003:** 1. Generation is being de-licensed and captive generation freely permitted. 2. No person shall: transmit electricity; or distribute electricity; or under take trading in electricity, unless he is authorized to do so by a license issued, exceptions are informed by authorized commissions through notifications. 3. Central Government may, make region-wise demarcation of the country, and, from time to time, make such modifications therein as it may consider necessary for the efficient, economical and integrated transmission and supply of electricity, Transmission utility at the central and state level to be a government company with responsibility of planned and coordinated development of transmission network. 4. Open access in transmission with provision for surcharge for taking care of current level of cross-subsidy, with the surcharge being gradually phased out. 5. The state governments are required to unbundle State Electricity Boards. However they may continue with them as distribution licensees and state transmission utilities. 6. Setting up State Electricity Regulatory Commission (SERC) has been made mandatory. 7. An appellate tribunal to hear appeals against the decision of (CERC's) and SERC's. 8. Metering of electricity supplied made mandatory. Provisions related to thefts of electricity made more stringent. 9. Trading as a distinct activity recognized with the safeguard of Regulatory commissions being authorized to fix ceiling on trading margins. 10. For rural and remote areas, stand-alone system for generation and distribution is permitted. 11. Thrust to complete rural electrification and provide for management of rural distribution by panchayat, cooperative societies, NGOs, franchisees etc. 12. Central government to prepare National Electricity Policy and Tariff Policy. 13. Central Electricity Authority (CEA) to prepare National Electricity Plan.	**04 M**
	d	**Give classification of biomedical waste.** **Ans:** **Classification of biomedical waste:** 1. Sharp waste 2. Pathological waste 3. Genotoxic waste 4. Pharmaceutical waste 5. Chemical waste 6. Infectious waste. 7. Hazardous waste. 8. Radioactive waste. 9. General waste (Municipal Solid Waste).	**04 M**
3.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a	**Distinguish between conventional and non conventional energy sources.** **Ans:**	

		Table: Distinguish between conventional and non conventional energy sources	**04 M**

Conventional energy sources	Non conventional energy sources.
1. These sources of energy are not abundant, present in limited quantity, e.g. coal, petroleum, natural gas.	1. These sources of energy are abundant in nature, e.g. solar energy, wind energy, tidal energy, biogas from biomass etc.
2. They have been in use for a long time	2. They are yet in development phase over the past few years
3. They are not replenished continuously. They are formed over a million years.	3. They are replenished continuously by natural processes.
4. They are called non-renewable sources of energy.	4. They are called renewable sources of energy.
5. They can be exhausted completely due to over-consumption except for hydel power.	5. They cannot be exhausted completely.
6. They pollute the environment by emitting harmful gases and also contribute to global warming	6. They are environment-friendly, do not pollute the environment.
7. Heavy expenditure is involved in using and maintaining these sources of energy	7. Using these sources is less expensive
8. They are used extensively, at a higher rate than the non-conventional sources	8. They are not used as extensively as conventional sources.

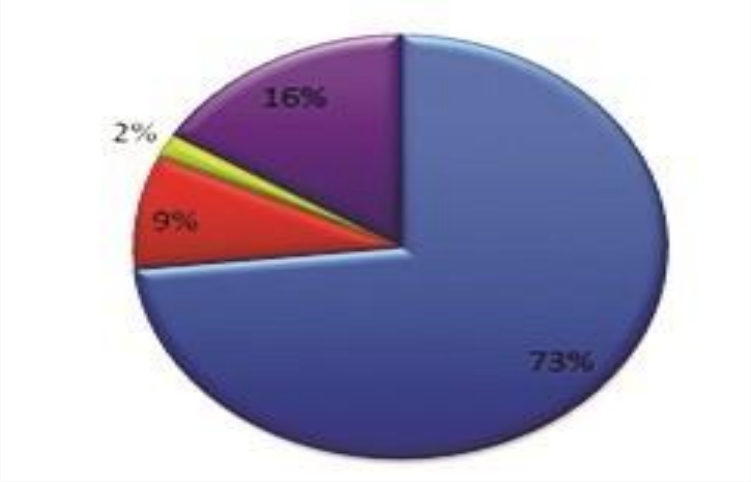
	b	**Enlist components of wind turbine. Write principle of wind power.** **Ans:** **Components of wind turbine:** Nacelle, rotor blades, hub, low speed shaft, gearbox, high speed shaft with its mechanical brake, electrical generator, yaw mechanism, electronic controller, hydraulics system, cooling unit, tower, anemometer and wind vane.	**02 M**
		Principle of wind power: When the wind strikes the rotor blades, blades start rotating. The turbine rotor is connected to a high-speed gearbox. Gearbox transforms the rotor rotation from low speed to high speed. The high-speed shaft from the gearbox is coupled with the rotor of the generator and hence the electrical generator runs at a higher speed. An exciter is needed to give the required excitation to the magnetic coil of the generator field system so that it can generate the required electricity. The generated voltage at output terminals of the alternator is proportional to both the speed and field flux of the alternator. The speed is governed by wind power which is out of control. Hence to maintain uniformity of the output power from the alternator, excitation must be controlled according to the availability of natural wind power. The exciter current is controlled by a turbine controller which senses the wind speed. Then output voltage of electrical generator (alternator) is given to a rectifier where the alternator output gets rectified to DC. Then this rectified DC output is given to line converter unit to convert it into stabilized AC output which is ultimately fed to either electrical transmission network or transmission grid with the help of step up transformer. An extra unit is used to give the power to internal auxiliaries of wind turbine (like motor, battery etc.), this is called Internal Supply Unit.	**02 M**
	c	**Explain the importance of energy audit.** **Ans:** **Importance of energy audit:** Energy audits reveal your usage patterns, identify waste, over-expenditure and, generally, make you fully cognizant of where your energy amounts are going. This knowledge will enable you to be more efficient with your energy use and be able to track and accelerate savings. An energy audit helps by revealing just how and where energy is	

		being wasted. Thus following points give you better understanding of why we need an energy audit: 1. It helps reduce energy costs in your facility. 2. It helps reduce the dependence on foreign energy sources. 3. It helps reduce environmental damage and pollution. 4. It can increase the security of your energy supply. 5. It can reduce the consumption of natural resources. 6. It can reduce damage to the environment associated with the exploitation of resources. 7. It helps you to increase the life span of the equipment in your facility. 8. It discovers any unaccounted consumption that may exist at the facility.	**04 M**
	d	**Describe need of biomedical waste management.** **Ans:** **Need of biomedical waste management:** Medical care is vital for our life and health, but the waste generated from medical activities presents a real problem. Improper management of waste generated in health care facilities causes a direct health impact on the community, health care workers, and the environment. Indiscriminate disposal of biomedical waste (BMW) or hospital waste and exposure to such waste pose serious threats to the environment and human health; hence, such waste requires specific treatment and management prior to its final disposal. Awareness about the need of BMW management among the health care personnel is of paramount importance. Thus below are the reasons due to which there is a great need for the management of hospital waste: 1. Injuries from sharps leading to infection in all categories of hospital personnel and waste handlers. 2. Nosocomial infections in patients due to poor infection control practices and poor waste management. 3. Risk of infection outside the hospital for waste handlers and scavengers and at times, for the general public living in the vicinity of hospitals. 4. Risks associated with hazardous chemicals and drugs to the persons handling wastes at all levels. 5. "Disposable" being repacked and sold by unscrupulous elements without even being washed. 6. Drugs that have been disposed of, being repacked, and sold off to unsuspecting buyers. 7. The risk of air, water, and soil pollution directly due to waste, or due to defective incineration emissions and ash.	**04 M**
4.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a	**Describe conventional power plants.** **Ans:** **Conventional power plants:** Conventional power plant is the general term applied to the production of electrical energy from coal, oil, or natural gas using the intermediary of steam. The generator is usually a synchronous machine having a small number of poles (two or four) and running at high speeds (1500–3600 rpm). The overall efficiency of energy conversion from fuel to electrical is greatly influenced by the poor efficiency of the turbine and condenser. Typical overall efficiency ranges from 30% to 40%. The main features of these conventional plants are their low capital cost per kilowatt installed as compared to other plants and virtually no limit on their size.	**04 M**

	b	**State different types of solar collectors.** **Ans:** **Different types solar collectors:** 1. Flat Plate Collectors 2. Evacuated Tube Collectors 3. Line Focus Collectors 4. Point Focus Collectors	**04 M**
	c	**Explain laws regarding environment protection.** **Ans:** **Laws regarding environment protection:** In India, Environmental law is governed by the Environment Protection Act, 1986. 1. Waste management laws govern the transport, treatment, storage, and disposal of all manner of waste, including municipal solid waste, hazardous waste, and nuclear waste, among many other types. Waste laws are generally designed to minimize or eliminate the uncontrolled dispersal of waste materials into the environment in a manner that may cause ecological or biological harm, and include laws designed to reduce the generation of waste and promote or mandate waste recycling. Regulatory efforts include identifying and categorizing waste types and mandating transport, treatment, storage, and disposal practices. 2. Air quality laws govern the emission of air pollutants into the atmosphere. Specialized subsets of air quality laws regulate the quality of air inside buildings. Air quality laws are often designed specifically to protect human health by limiting or eliminating airborne pollutant concentrations. Other initiatives are designed to address broader ecological problems, such as limitations on chemicals that affect the ozone layer, and emissions trading programs to address acid rain or climate change. Regulatory efforts include identifying and categorizing air pollutants, setting limits on acceptable emissions levels, and dictating necessary or appropriate mitigation technologies. 3. Water quality laws govern the release of pollutants into water resources, including surface water, ground water, and stored drinking water. Some water quality laws, such as drinking water regulations, may be designed solely with reference to human health. Many others, including restrictions on the alteration of the chemical, physical, radiological, and biological characteristics of water resources, may also reflect efforts to protect aquatic ecosystems more broadly. Regulatory efforts may include identifying and categorizing water pollutants, dictating acceptable pollutant concentrations in water resources, and limiting pollutant discharges from effluent sources. Regulatory areas include sewage treatment and disposal, industrial and agricultural waste water management, and control of surface runoff from construction sites and urban environments. 4. Environmental cleanup laws govern the removal of pollution or contaminants from environmental media such as soil, sediment, surface water, or ground water. Unlike pollution control laws, cleanup laws are designed to respond after-the-fact to environmental contamination, and consequently must often define not only the necessary response actions, but also the parties who may be responsible for undertaking (or paying for) such actions. Regulatory requirements may include rules for emergency response, liability allocation, site assessment, remedial investigation, feasibility studies, remedial action, post-remedial monitoring, and site reuse. 5. Chemical safety laws govern the use of chemicals in human activities, particularly man-made chemicals in modern industrial applications. As contrasted with media-	**04 M (Any Four)**

		oriented environmental laws (e.g., air or water quality laws), chemical control laws seek to manage the (potential) pollutants themselves. Regulatory efforts include banning specific chemical constituents in consumer products	
	d	**Describe effect of medical waste on environment.** **Ans:** **Effect of medical waste on environment:** The negative effects that can result from the poor management of collection methods and the disposal of solid waste resulting from health institutions, whether in terms of the safety of the medical staff working within the institution or in terms of environmental safety in general, to the presence of the medical institution or at the city level. The disposal of solid waste in terms of management and procedures may lead to the spread of pollutants in these wastes by insects, rodents or wind, as well as rain or floods that may lead to the leakage of these substances through the juices resulting in soil or groundwater. The discharge of liquids from these wastes to wastewater may in turn lead to the transfer of these substances to the groundwater or food chain. The landfill of medical waste on both landfill and the transfer of these pollutants to soil or landfill at the seabed, which may pose a major threat to the environment and fisheries. The combustion products and incinerators of these wastes are considered to be improper or inadequate, i.e. at relatively low temperatures (below 1200 oC). These gases are then released into the air to be deposited later or transmitted through rainwater to the land or plantations where incineration of medical waste is an essential source of emission. Dioxin or mercury is considered a carcinogen. Burning is therefore supposed to destroy materials in which infectious materials such as paper, cardboard, plastics, glass and metal are found. During this process, acid gases are generated [by the existing chlorine plastic]. In a study by the US Environmental Protection Agency, medical waste incinerators are considered to be a major source of dioxin and mercury pollution in the environment and in food stock. 1. Improper segregation of biomedical waste and different medical waste streams from the point of origin can trigger a domino-like effect on the environment that incurs dangers to people, animals, or soil and water sources. 2. Improper segregation and disposal of biomedical waste has the potential to contaminate groundwater sources, which in turn may infect humans and animals alike. 3. From a hospital's waste and storage receptacles to landfills, biomedical waste needs to be properly contained to keep it away from birds, rodents, and stray animals (as well as humans). This enhances packaging and labeling of contaminants and helps prevent the spread of illness through human and animal populations – by air, land, or water. 4. If not properly contained, segregated, and incinerated through on-site or off-site incineration, environmental hazards associated with improper healthcare waste management can contaminate the air we breathe through dangerous airborne particles. 5. Radioactive particles produce with diagnostic technologies has the potential to reach a landfill or other areas of the environment, especially air. Air pollutants disseminated over huge areas of inhabited land have the potential to trigger a number of illnesses.	**04 M**
	e	**Describe the different types of labels used for biomedical waste.** **Ans:** **Labels for Bio-Medical Waste Containers/Bags:**	

		<table><tr><th>BIOHAZARD SYMBOL</th><th>CYTOTOXIC SYMBOL</th></tr><tr><td>  </td><td>  </td></tr></table> **HANDLE WITH CARE** Labels shall be non-washable and prominently visible. LABEL FOR TRANSPORT OF BIO-MEDICAL WASTE CONTAINERS/BAGS Day…… Month……. Year …….. Date of generation……. Waste category No…… Waste Class ……. Waste description…… Sender's Name & Address Receiver's Name & Address Phone No…… Phone No…….. Telex No……. Telex No…… Fax No…… Fax No…….. Contact Person…….. Contact Person…….. In case of emergency please contact: Name & Address ……. Phone No……	**04 M**
5.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	a	**Describe the present scenario of energy in Maharashtra and India.** **Ans:** **Present scenario of energy in Maharashtra and India:** India is the world's third largest producer and third largest consumer of electricity. The national electric grid in India has an installed capacity of 364.17 GW as of 31 October 2019. Renewable power plants, which also include large hydroelectric plants, constitute 34.86% of India's total installed capacity. During the 2018-19 fiscal years the gross electricity generated by utilities in India was 1,372 TWh and the total electricity generation (utilities and non utilities) in the country was 1,547 TWh. The gross electricity consumption in 2018-19 was 1,181 kWh per capita. In 2015-16, electric energy consumption in agriculture was recorded as being the highest (17.89%) worldwide. The per capita electricity consumption is low compared to most other countries despite India having a low electricity tariff. India has a surplus power generation capacity but lacks adequate distribution infrastructure. To address this, the Government of India launched a program called "Power for All" in 2016. The program accomplished by December 2018 in providing the necessary infrastructure to ensure uninterrupted electricity supply to all households, industries, and commercial establishments. Funding is supplied through collaboration between the Government of India and its constituent states. India's electricity sector is dominated by fossil fuels, in particular coal, which during the 2018-19 fiscal year produced about three-quarters of the country's electricity. The government is making efforts to increase investment in renewable energy. The government's National Electricity Plan of 2018 states that the country does not need more non-renewable power plants in the utility sector until 2027, with the commissioning of 50,025 MW coal-based power plants under construction and addition of 275,000 MW total renewable power capacity after the retirement of nearly 48,000 MW old coal-fired plants. Installed capacity by source in India as 31 October 2019 Coal: 203,954.5 MW (56.1%), Large Hydro: 45,399.22 MW (12.5%), Small Hydro: 4,610.81 MW (1.3%), Wind Power: 36,930.32 MW (10.2%), Solar Power: 31,101.71 MW (8.6%), Biomass:	**03 M**

		9,271.3 MW (2.6%), Nuclear: 6,780 MW (1.9%), Gas: 24,937.22 MW (6.9%), Diesel: 509.71 MW (0.1%) Maharashtra is a state in the western region of India and is the nation's third largest state and also the world's second-most populous sub-national entity. Its population makes Maharashtra one of the largest energy users of country. The high electricity demand of the state constitutes 13.91% of the total installed electricity generation capacity in India. Maharashtra has 38,372.83 MW of installed capacity. Out of this, 28,145.20 MW generate from thermal (coal & gas) plants, 690.14 MW from nuclear plants, 3,331.84 MW from hydro plants and 6,205.65 from Renewable Energy Sources (RES) like solar, wind etc. Fuel-wise installed capacity in Maharashtra is given below. The fig shows percentage of energy generation in Maharashtra by different sources.  Thermal-73% Hydro-9% Nuclear-2% RES-16% **Fig: shows percentage of energy generation in Maharashtra by different sources.** **Any other relevant answer shall be considered.**	**03 M**
	b	**Describe WHO guidelines on management of waste from hospital wastes.** **Ans:** **WHO guidelines on management of waste from hospital waste:** **Minimal observance for waste minimization / recycling and waste handling** Make sure infectious and hazardous HCW are properly segregated from general waste so as to reduce disposal costs and increase materials for recycling; ‰ Ensure a proper stock management of the pharmacies in the hospitals by using adequate delivery and stock position forms; ‰ Purchase durable equipment, furnishing and supply; ‰ Explore waste recycling options for food or garden waste such as composting. **Minimal observance for waste segregation and labeling** Establish a three-bin system with appropriate labeling in all the HCFs of the country as follows. 1. General HCW (black bags/bins; no symbol); 2. Potentially infectious HCW (yellow bags/bins; biohazard symbol); 3. Used sharps, including broken glass (yellow containers; biohazard symbol); ‰ Ensure awareness and training for medical staff and waste managers for waste segregation and labeling. **Minimal observance for waste collection and transportation** Each HCF should have an HCWM plan which should include collection points and routes of waste transport. A timetable of the frequency of collection should also be set-up; ‰ Provide heavy duty gloves, industrial boots and apron for waste collectors; ‰ Ensure that waste containers are appropriately sealed, removed and replaced immediately	**06 M**

		when they are no more than three-quarters full; ‰ Ensure that hazardous / infectious HCW and non-risk HCW are collected on separate trolleys which should be marked with the corresponding colour (black/yellow) and washed regularly. **Minimal observance for on-site storage of HCW.** Ensure that a dedicated place, lockable and with no possibility for animals / insects to have access is designed to store hazardous / infectious HCW; ‰ Ensure that HCW isn't stored for more than 24 hours before being treated / disposed of. **Minimal observances for off-site transportation of waste.** Ensure that the responsible authorities always approve the off-site transportation plan before any transit occurs; ‰ Ensure that all categories of HCW are collected every second day at least; ‰ Ensure that each HCF practicing off-site transportation is aware of the final destination of the HCW they produce. **Minimal observances for waste treatment and disposal.** Ensure that the most hazardous HCW (i.e. sharps) and (highly) infectious waste are properly treated and disposed of in all HCFs of the country; ‰ Ensure that treatment / disposal options that will be recommended in the National HCWM plan will be homogeneously applied in the country; ‰ Ensure that the selected options will be compatible with the local operation and maintenance capacities; ‰ Always select the most environmental friendly options taking into consideration the operation and maintenance costs.	
	c	**Draw and explain flow chart of biomedical waste management processes.** **Ans:** **Process of Biomedical Waste Management:** Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of bio-medial waste in any establishment. There are various categories of Biomedical Wastes. 1. Identifying the categories of biomedical waste is by sorting the waste into colour coded plastic bags or containers. Biomedical waste is segregated into containers/bags at the point of generation General waste like garbage, garden refuse etc. join the stream of domestic refuse. Sharps are collected in puncture proof containers. Bags and containers for infectious waste are marked with Biohazard symbol. Highly infectious waste is sterilized by autoclaving. Cytotoxic wastes are collected in leak proof containers dearly labeled as cytotoxic waste. Needles and syringes are destroyed with the help of needle destroyer and syringe cutters provided at the point of generation. Infusion sets, bottles and gloves are cut with curved scissors. Disinfection of sharps, soiled linen and plastic and rubber goods is achieved at point of generation by usage of sodium hypochlorite with minimum contact of 1 hour. Fresh solution should be made in each shift. 2. Kerb side storage area is impermeable and hard standing with good drainage. It provides an easy access to waste collection vehicle. 3. Biomedical waste is transported within the hospital by means of wheeled trolleys, containers or carts that are not used for any other purpose. The trolleys are cleaned daily. Off site transportation vehicle is marked with the name and address of carrier. 4. Final treatment of the biomedical waste is done by using technologies like incineration, autoclave, hydro-clave or microwave disposed by recycling or landfilling. 5. Waste water treatment plant is installed for reuse of waste water.	**03 M**

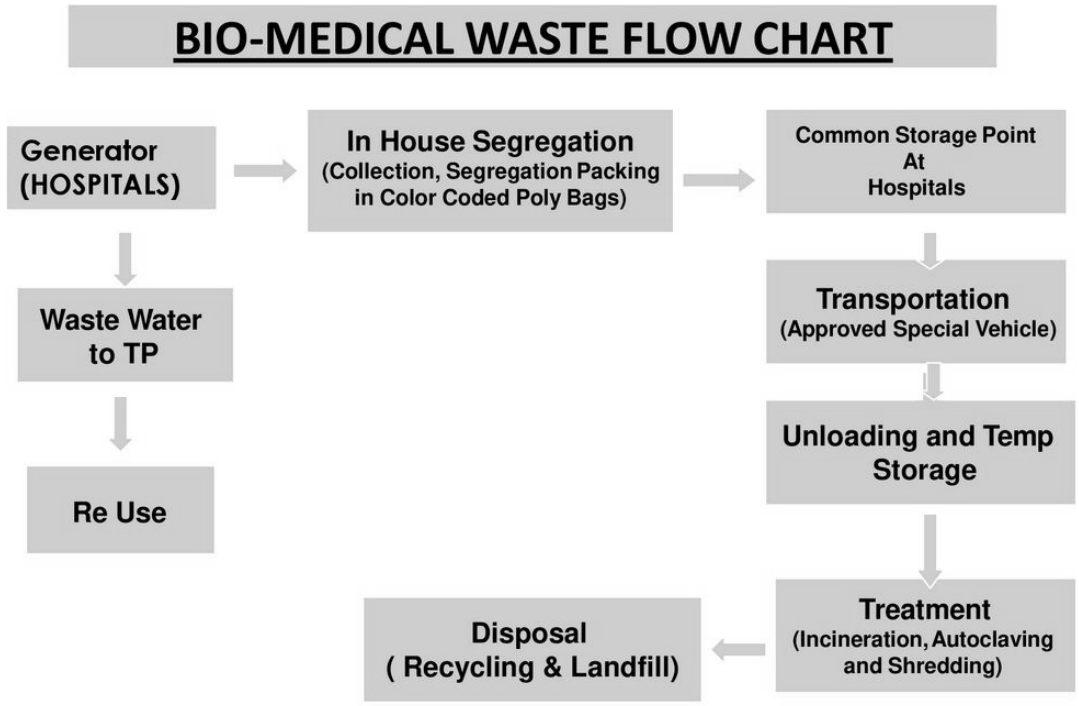


Fig: Biomedical Waste Flow Chart — **03 M**

6.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	a	**Explain factors affecting the production of biogas from biomass.** **Ans:** **Factors Affecting Biogas Production:** 1. Temperature: The ideal temperature is 30-40°C 2. pH: while the pH is 6-8, for good yield. 3. Slurry composition: The ratio between solid and water composition in the slurry should be around 1: 1. A carbon nitrogen ratio of 30: 1 in the slurry results in optimal methane production. Good mixing and solubilization of the organic constituents is required. 4. Loading rate: Is the amount of raw materials fed per unit volume of digester capacity per day. 5. Retention time: Is the average period that the given quantity of input remains in the digester to be acted upon by the methanogens. 6. Anaerobic conditions: The digester should be completely airtight, so as to create suitable anaerobic conditions. 7. Presence of inhibitors: Ammonium sulfate and antibiotics inhibit methane production.	**06 M**
	b	**Describe energy conservation act 2001. Also state its features.** **Ans:** **The Energy Conservation Act, 2001:** The purpose of this act is to provide for efficient use of energy and its conservation. Provide a policy frame work and direction to national energy conservation activities. Coordinate policies and programs on efficient use energy with stakeholders. Establish systems and procedures to verify measure and monitor Energy Efficiency	**03 M**

		improvement. Demonstrate Energy efficiency delivery system through public private partnership and to promote Energy Efficiency in the country. **Important features of the Energy Conservation Act are:** 1. Energy conservation building code (ECBC) - a) Bureau of energy efficiency to prepare guide lines on ECBC. b) To provide minimum requirements for energy efficient design and construction of buildings. 2. Standards and Labeling (S&L)- The S & L program, when in place would ensure that only energy efficient equipment and appliance would be made available to the consumers. 3. Demand Side Management 4. Bachat Lamp Yojana (BLY)-CDM based lighting projects for household. 5. Promoting Energy efficiency in Small and Medium Enterprises.(SMEs) 6. Designated consumers to: a) Get energy audit by accredited energy audit firms b) Implement cost effective recommendations c)Appoint or designate energy managers d) Comply with energy consumption norms. 7. Certification of Energy Managers and Energy Auditors	**03 M**
	c	**State safety and precautionary measures used for waste management.** **Ans.** **Safety and precautionary measures used for waste management:** 1. Every hospital must have a plan programmed of awareness and adequate training for all categories of personnel including Administrators in issues like infection risk, mode of transmission, sign and symptom, and mode of prevention of diseases that could be transmitted through medical waste. 2. Personal protective Equipment (PPE) such as hand glove, apron, face mask, long sleep (trouser and shirt) boot and goggles must appropriately be used while at work to reduce the risk of workers exposure to infection. The employer must ensure that the workers or employees use the protective device as well as ensure sustainable supply of the device throughout the exposures. 3. Hand should always be washed with soap and running water. After removal of gloves kept in a good condition, protective clothing must be clean after each use and be kept at healthcare facility protective clothing must never be taken to home. 4. Hepatitis B vaccine and Tetanus toxoid vaccination are frequently given to the employees to ensure their protection against Hepatitis B and tetanus. This in particular is needed for those expose to the risk of infection. 5. All efforts should be made to limit the length of exposure subjecting the staff to adequate shifting to reduce the length of exposure. 6. If an exposure incident occurs employees should immediately report exposure incidents. The employer is responsible for establishing the procedure for evaluating. 7. There should not be compromise of standard in matters to do with medical waste management in hospital if the health and well-being of peoples to be protected against likely infection that are transmitted through pathological waste.	**06 M**