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SEMESTER END THEORY EXAMINATION

B.Sc. (Hons.) Agriculture

Semester	: VI	Term	:II	Academic year	: 2021-22
Course No.	: FST 362	Title	: Principles of Food Science and Nutrition		
Credits	:2(2+0)		:		
Day & Date	:	Time (hrs)	: 3 hrs	Total marks	: 80

MODEL ANSWERS

Q.1	a.	Write objectives of food science and enlist physical properties of food.	4
Answer :		**Objectives of food science :** 1. To understand the functions of foods, which supply our nutritional and physiological needs. 2. To know how to select foods to meet our need for nutrients from available foods or basic food groups. 3. To understand the composition of food and the changes that occurs during preparation, so that these changes can be controlled to prepare acceptable food products to meet our body's needs. 4. To learn the methods of food preparation which blend acceptability with retention of nutrients. 5. The economic management of food budget to meet family's needs efficiently. 6. Food preservation as an aid to increase variety and food availability. 7. Safeguarding the food supply through sanitary handling and preparation to avoid food-borne diseases.	(2)
		Physical properties of food 1. Shape and size 2. Density 3. Specific gravity 4.Porosity 5. Surface area 6. Specific weight 7. Viscocity 8.Volume	(2)
Q.1	b.	Define bioactive and write in brief about the bioactive compounds.	4
Answer:		**Definition :** Bioactives are usually substances that have been isolated or derived from plants and other living systems. Bioactive compounds are extra-nutritional constituents that typically occur in small quantities in foods.	(1)
		Types of Bioactive compounds: 3 Marks **1. Flavonolds 2. Carotenolds 3. Polyphenols.** **1.FLAVONOIDS:** Flavonoids are a diverse group of phytonutrients (plant chemicals) found in almost all fruits and vegetables. Flavonoids are	(3)

		polyphenolic compounds that are ubiquitous (everywhere) in nature. Flavonoids are present in coloured capcicum and red vegetables **2.CAROTENOIDS:** are organic pigments that are found in the chloroplasts and chromo-plasts of plants and some other photosynthetic organisms like algae, some bacteria, and some fungi. Carotenoids, also called tetraterpenoids, are yellow, orange, and red organic pigments that are produced by plants and algae, as well as several bacteria, and fungi. Carotencids give the characteristic color to pumpkins, carrots, com, tomatoes, canaries, flamingos, salmon, lobster, shrimp, and daffodils. Carotenoids present in cow milk, mango papaya ,cucumber etc **3.POLYPHENOLS**: a compound containing more than one phenolic hydroxyl group. Polyphenols are a structural class of mainly natural, but also synthetic or semisynthetic, organic chemicals. Many foods in a healthy diet contain high levels of naturally occurring phenols in fruits, vegetables, cereals, tea and coffee. Polyphenols are present in bajara, jowar grains.	
Q.2	a.	What do you understand about the term genetically modified foods?	4
Answer:		Genetically approaches are to be applied to increase the content of iron in the newly developed varieties of bajra and rice. According to the World Health Organization, "Foods produced from or using GM organisms are often referred to as GM foods. Genetically modified foods (GM foods), also known as genetically engineered foods (GE foods), or bioengineered foods are foods produced from organisms that have had changes introduced into their DNA using the methods of genetic engineering. Genetic engineering techniques allow for the introduction of new traits as well as greater control over traits when compared to previous methods, such as selective breeding and mutation breeding. Most food modifications have primarily focused on cash crops in high demand by farmers such as soybean, corn, canola, and cotton. Genetically modified crops have been engineered for resistance to pathogens and herbicides and for better nutrient profiles. **Examples of GM foods are:** In 1998, scientists developed a transgenic fruit called rainbow papaya, which is resistant to the papaya ring spot virus **Milk:** RGBH, or recombinant bovine growth hormone, is a GE variation on a naturally occurring hormone injected into dairy cows to increase milk production. Zucchinis have been bioengineered to be virus resistant. **Golden rice** is a variety of rice (*Oryza sativa*) produced through genetic engineering to biosynthesize beta carotene, a precursor of vitamin A, in the edible parts of rice. It is intended to produce a fortified food to be grown and consumed in areas with a shortage of dietary vitamin A, a deficiency which each year is estimated to kill 670,000 children under the age of 5 and cause an additional 500,000 cases of irreversible childhood blindness. Many food crops are genetically modified for the insect, pest, disease resistance.	
Q.2	b.	What are carbohydrates ? Classify oligosaccharides with suitable example.	4

Answer: **Carbohydrates** are defined as polyhydroxy aldehydes or polyhydroxy ketones and the substances which yield these derivatives on hydrolysis. (1)

Olignsaccharide:- Definition - Oligosaccharides are polymers of monosaccharides containing two to ten residues accumulate in vacuole while polysaccharides in plastids, they are classified as (3)

a) **Disaccharides** - yield two monosaccharides on hydrolysis.

i) **Reducing disaccharides** - e.g. Maltose (Glucose + glucose), Lactose (galactose + glucose), other examples are isomaltose, cellobiose.

ii) **Non reducing disaccharides** - Sucrose (glucose + fructose)

b) **Trisaccharides** - e.g. Raffinose - (glucose + fructose + galactose) found in cotton seed and sugar beet.

c) **Tetrasaccharides** - yield 4 monosaccharides on hydrolysis e.g. stachyose (glucose + fructose + galactose + galactose) (only tetrasaccharide known to exist in plant).

Q.3 a. Define vitamin and mention the sources and deficiency disorders of vitamin C and vitamin D.

Answer: **Vitamin** - Vitamins may be defined as organic compounds occurring in small quantities in the different natural foods and necessary for the growth and maintenance of good health in human beings and certain experimental animals. (1)

Vitamin	Sources	Deficiency disorders
Vitamin C	Citrus fruits, sprouted pulses and soaked cereals	Prolonged deficiency of vitamin C produces scurvy. In mild deficiency fatigue, weakness, irritability and frequent infections occur. Pain in bones is common
Vitamin D	Fish liver oils, egg yolk, milk, butter, ghee	Rickets in children and osteomalacial in adults

(3)

Q.3 b. Enlist chemical properties of food and explain coagulation. (4)

Answer: **Chemical properties of food** (2)

1. Carbohydrates
2. Amino acids and proteins
3. Lipids
4. Other components – nucleic acids, pigments, organic acids, polyphenols and tannins, flavoring agents, vitamins, water.
5. Osmotic pressure
6. Food dispersions
7. Food sols and gels
8. Food gels
9. Emulsions
10. Browning of food
11. Formation of foam
12. pH concentration
13. Denaturation
14. Coagulation

COAGULATION:
It is defined as the change in the structure of protein (from a liquid form to solid or a thicker liquid) brought by heat, mechanical action or acids. Enzymes may also cause protein coagulation e.g. cheese making. (2)

Q.4 a. Define balanced diet and give the difference between high and low calorie diet. (1)

Answer:

Defination : A balance diet may be defined as one which contains various groups of food stuffs such as energy yielding foods, body building foods and protective foods in the correct proportion so that individual is assured of obtaining the minimum requirements of all the nutrients.

	High calorie diet.	Low calorie diet.
1.	This is a normal diet with an increase in the calorie level to 3000 or more.	This is a normal diet with energy values reduced to 1500, 1200 or 1000 calories.
2.	These diets are prescribed for weight loss, fever, hyperthyroidism, burns etc.	These diets are prescribed for reducing body weight in diabetes mellitus, cardiovascular diseases, hypertension, gout, gall bladder disease, preceding surgery.
3.	High calorie diet is to be given to the hard workers e.g. labour	Low calorie diet is to be given to the non-labor workers
4.	Eg. Red meat, chicken, eggs, cheese	Eg vegetables, fruit juice, breads and grains

(3)

Q.4 b. Describe the process of wine making from grapes. (4)

Answer:

Process of wine making from grapes :

1.Crushing of grapes
2.Fermentation yeast used is *Saccaromyces cerevisiae* var. *ellipsoideus*
3.Ageing and Storage
4.Clarification
5.Packaging

The Cabernet France, Carmenere, Chardonnay, Malbec, Merlot etc. grape varieties used for wine making.

Q.5 a. Write the note on FASSAI and CFTRI. (2)

Answer:

1.Food Safety and Standards Authority of India (FSSAI) : is an autonomous body established under the Ministry of Health & Family Welfare, Government of India. The FSSAI has been established under the Food Safety

		and Standards Act, 2006 which is a consolidating statute related to food safety and regulation in India. FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safety. The FSSAI has its headquarters at New Delhi. The authority also has 6 regional offices located in Delhi, Guwahati, Mumbai, Kolkata, Cochin, and Chennai, 14 referral laboratories notified by FSSAI, 72 State/UT laboratories located The FSSAI is headed by a non-executive Chairperson, appointed by the Central Government, either holding or has held the position of not below the rank of Secretary to the Government of India. **2.Central food technology research institute (CFTRI):** It is located at Mysore and started in 21st Oct 1950. It is a constituent lab of Council for Scientific and Industrial Research (CSIR), New Delhi. Promotes and aids the conservation of food resources as well as maximize the utilization and value addition for economic growth thus contributing to food security through science and technology. A regional center is present at Hyderabad. It has about 15 research and development departments which attained excellence in every discipline of Food Science and Technology. It gives man power training to industry personnel. **Activities:** • Technology transfer on cost basis. • Human resource development. • Industrial services with prescribed fees. • Project identification and evaluation. • Preparation of industry feasible project reports for processes and products. • Market research. • Identification of post harvest problems. • Assistance in process control, quality assurance packing and product diversification. • Machinery selection, installation, operation of plants and operational research in food industries. • Techno economic and pre-investment surveys. • Project engineering and design. • Resource inventories and publications. • Offers technologies in post harvest handling, storage and processing of various kinds of foods.	(2)
Q.5	b.	How to prevent the microbial decomposition of food ?	(4)
Answer:		1) By keeping out micro-organisms : 2) By removal micro-organisms (Filtration) 3) By hindering the growth and activity of micro-organisms a. By using low temperature b. By drying of food commodity c. By creating anaerobic conditions d. By use of chemicals: 4) By killing the micro-organisms	

a)Pasteurization (heating below 100°C)
b)Boiling (heating at 100°C)
c)Heating above 100°C
5)Use of radiation

Q. 6 a. Differentiate between over nutrition and under nutrition in human. (4)

Answer:

	Over nutrition	Under nutrition
1.	It is the over consumption of nutrients and food to the point at which health is adversely affected.	It is the outcome of insufficient food intake and repeated infectious diseases.
2.	It causes overweight and obesity.	It causes kwashiorkor and marasmus nutritional disorders.
3.	It does not related with growth failure, micronutrient malnutrition	It is related with growth failure, micronutrient malnutrition
4.	Causes of over nutrition are excessive Intake of lipids, excessive Intake f carbohydrates, excessive intake of proteins	Causes for under nutrition are poverty, population explosion, ignorance and illiteracy, infections, low food availability and uneven distribution of food, poor post harvest handling of food, Policies

Q.6 b. State the role of nanotechnology in food science.

Answer: (4)

Role of nanotechnology :

1.To create utilize and manipulate materials, devices, or systems at the nanometer scale.

2. To provide provide opportunities to improve the sensory qualities of food such as taste, texture, and color.

3. To provide nano materials to improve protection mechanisms for food.

4. To provide nano sensors and nano packaging materials for rapid, sensitive, and reliable detection of microbial contamination, harmful chemicals, and pesticides.

5. To improve food processing by enabling the delivery of bioactive compounds for enhancing bioavailability in foods.

6. To provide nanomaterial's for food Packaging.

7. To provide nano materials with antimicrobial properties on the packaging surface of packaging material.

8. It is used to maintain the hygienic condition of the food contact surface by preventing or reducing microbial growth and helping 'clean ability.

9. To be used in common in some reusable food containers such as boxes and crates and the inside liners of refrigerators and freezers also.

10. Nano sensors can detect certain chemical compounds, pathogens and toxins in food, eliminate the need for inaccurate expiration dates & provides real-time status of food freshness. Examples of nano sensors in packaging.

Q.7 a. Enlist types of food fortification and explain household/community fortification.

Answer: **Types of food fortification** (2)

		1. Mass Fortification 2. Targeted Fortification 3. Market driven Fortification 4. Household/community Fortification 5. Bio Fortification **Household/community fortification** The effectiveness of several different types of products, including soluble or crushable tablets, micronutrient-based powder ("sprinkles") and micronutrient-rich spreads are currently being evaluated. Crushable tablets, and especially micronutrient-based powder, are relatively expensive ways of increasing micronutrient intakes, certainly more costly than mass fortification, but may be especially useful for improving local foods fed to infants and young children, or where universal fortification is not possible. The micronutrient-dense fortified bread spreads have been found to be very popular with children.. Fortification of foods at the community level is also still at the experimental stage. This approach involves the addition of a commercial micronutrient premix, available in sachets, to small batches of flour during the milling process. Although feasible in theory, major challenges to local-scale fortification programmes include the initial cost of the mixing equipment, the price of the premix (which would need to be imported in most cases), achieving and maintaining an adequate standard of quality control (e.g. in uniformity of mixing), and sustaining monitoring and distribution systems.	(2)
Q.7	b.	Explain factors affecting on growth of microorganisms in food.	
Answer:		1.Nutrients and other constituents in food 2.Acidity 3.Water content 4.Physical and environmental factors 5.Availability of oxygen 6.Presence of inhibitory substances 7.Biological structure	(4)
Q.8	a.	Discuss in brief xerophthalmia and fluorosis nutritional disorders.	
Answer:		**1.Xerophthalmia:** Xerophthalmia is a medical condition in which the eye fails to produce tears. It may be caused by vitamin A deficiency, which is sometimes used to describe that condition, although there may be other causes, Xerophthalmia caused by a severe vitamin A deficiency is described by pathologic dryness of the conjunctiva and cornea. The conjunctiva becomes dry, thick and wrinkled. If it is untreated, it can lead to corneal ulceration and ultimately to blindness as a result of corneal damage. Xerophthalmia usually implies a destructive dryness of the conjunctival epithelium due to dietary vitamin A deficiency a rare condition in developed countries, but still causing much damage in developing countries. Other forms of dry eye are associated with aging, poor lid	(2)

		closure, scarring from a previous injury, or autoimmune diseases such as rheumatoid arthritis and these can all cause chronic conjunctivitis. **2. Flurosis.** Fluorosis is a condition resulting due to ingestion of large amounts of fluorine when the drinking water contains fluorides in excess of 3-5 ppm. Fluorides are present in the environment. Excessive systemic exposure to fluorides can lead to disturbances of bone homeostasis (skeletal fluorosis) and enamel development (dental/enamel fluorosis). The severity of dental fluorosis is also dependent upon fluoride dose and the timing and duration of fluoride exposure. Dental and skeletal fluorosis is known health hazards. Fluoride deficiency leads to dental caries.	(2)
Q.8	b.	Enlist sensory properties of food and explain aroma.	
Answer:		**Sensory properties of food** 1. Appearance 2. Flavor 3. Taste 4. Texture 5. Sound 6. Aroma **Aroma**: It is the sensation that results when olfactory receptors in the nose are stimulated by particular chemicals in a gaseous form. Eg. Floral, Rotten, Perfumed, Acrid, Musty, Fragrant, Scented, Pungent etc.	(2) (2)
Q.9	a.	Why fortification is necessary ?. What are its benefits?	
Answer:		**fortification is necessary for :** 1. The 70% of people in India do not consume enough micronutrients such as vitamins and minerals. 2. About 70 percent of pre-school children suffer from anaemia caused by Iron Deficiency and 57 percent of preschool children have sub-clinical Vitamin A deficiency. 3. Neural Tube Defects (NTDs) are the most common congenital malformation with an incidence that varies between 0.5-8/1000 births. 4. It is estimated that 50-70% of these birth defects are preventable. One of the major causes is deficiency of Folic Acid. 5. Thus, deficiency of micronutrients or micronutrient malnutrition, also known as "hidden hunger", is a serious health risk. 6. Unfortunately, those who are economically disadvantaged do not have access to safe and nutritious food. 7. Others either do not consume a balanced diet or lack variety in the diet because of which they do not get adequate micronutrients. 8. Often, there is considerable loss of nutrients during the processing of food. 9. One of the strategies to address this problem is fortification of food. 10. This method complements other ways to improve nutrition such as diversification of diet and supplementation of food. **Benefits of Fortification**	(2)

		1. Since the nutrients are added to staple foods that are widely consumed, this is an excellent method to improve the health of a large section of the population, all at once. 2. Fortification is a safe method of improving nutrition among people. 3. The addition of micronutrients to food does not pose a health risk to people. 4. The quantity added is so small and so well regulated as per prescribed standards that likelihood of an overdose of nutrients is unlikely. 5. It does not require any changes in food habits and patterns of people. 6. It is a socio-culturally acceptable way to deliver nutrients to people. 7. It does not alter the characteristics of the food-the taste, the feel, the look. 8. It can be implemented quickly as well as show results in improvement of health in a relatively short period of time. 9.This method is cost-effective especially if advantage is taken of the existing technology and delivery platforms. 10.The Copenhagen Consensus estimates that every 1 Rupee spent on fortification results in 9 Rupees in benefits to the economy. 11. It requires an initial investment to purchase both the equipment and the vitamin and mineral premix, but overall costs of fortification are extremely low. 12. Even when all program costs are passed on to consumers, the price increase is approximately 1-2%, less than normal price variation. Thus it has a high benefit-to-cost ratio.	(2)
Q.9	b.	Define preservatives and give the role of preservatives in food processing.	
Answer:		**Preservative :** Preservative is defined as any substance which is capable of inhibiting, retarding, or arresting, the growth of micro organisms, of any deterioration of food due to micro-organisms, or of masking the evidence of any such deterioration. **Role of preservatives in food processing:** 1. Preservatives are added to food to fight spoilage caused by bacteria moulds, fungus and yeast. 2. Preservatives can keep food fresher for longer periods of time, extending its shelf life. 3. Food preservatives also are used to slow or prevent changes in colour, flovour, or texture and delay rancidity. 4. In addition to maintaining the quality of the food, preservatives help to control contamination that can cause foodborne illness, including life threatening diseases. 5. It blocks growth of bacteria, moulds and yeasts 6. To minimize enzyme activity which promote natural ripening of fruits and vegetables	(1) (3)
Q.10	a.	Explain the yellow revolution and blue revolution national food programmes in India.	(4)

Answer:		**1. Yellow Revolution (Oilseed Production)** The yellow revolution in oilseeds owes its earlier success to a spectacular increase in output to 22 and 24.75 million tonnes in 1994-95 and 1998-99 from 10.83 and 11 million tonnes in 1985-86 and 1986-87. But thereafter, we have not been able to achieve self-sufficiency in oilseeds. Current production is not enough to meet the needs of cooking oils of our growing population, The spectacular success of the yellow revolution in 1998-99 could be attributed to an increase in the cultivable area to about 26 million hectares and an integrated approach that gave over-riding priority through a technology mission. Aimed at accelerating self-reliance in oilseeds, the approach adopted envisaged developing and taking modern technological inputs to farmers, thereby providing them incentive prices and storage and processing facilities. The National Dairy Board was entrusted with the task to develop groundnut production in Gujarat through farmers' oilseeds societies. The national Oilseeds and Vegetable Oils Development Board was entrusted to popularize oilseeds in non-traditional areas. Also, an oilseeds production thrust project was initiated to accelerate production of four major oilseeds-groundnut, mustard-rapeseed, soybean and sunflower. **2.Blue Revolution (Fish production)** India is pushing ahead with a Blue Revolution, the rapid increase of fish production in small ponds and water bodies, a boon to small farmers, the nation's nutrition and its gross domestic product. The Indian fisheries sector, which 50 years ago produced only 600 000 tonnes of fish, today produces 5 million tonnes, including 1.6 million tonnes from freshwater aquaculture. Although the yield from marine fisheries has stagnated, freshwater aquaculture is growing at a healthy 6 percent a year. "Fish culture was an art in India. We had to make it a science," said Dr V.R.P. Sinha, the founding director of the Central Institute of Freshwater Aquaculture (CIFA), India's largest centre of its kind and the source of much of the science that has driven the growth of Indian inland aquaculture. The institute began the challenging task of turning what was a minor village tradition into a science that not only could increase the tonnage of fish per volume of water but also cope with inevitable problems that come with more intensive production, such as how to feed fish economically and how to deal with sudden outbreaks of disease brought on by crowded conditions.	(2) (2)
Q.10	b.	Explain metabolism of protein in human.	

Answer:	The breakdown of tissue protein is **'catabolism'** and the formation of new tissue proteins is called **'anabolism'**. **Protein metabolism : Digestion & Absorption of protein** The digestion of proteins takes place in the stomach and intestines. As a result of digestion, the proteins are broken down to amino acids and absorbed. **1. Gastric digestion** The proteolytic enzyme present in gastric juice is called as pepsin which acts on proteins in an acid medium and hydrolyse them to simpler compounds known as polypeptides. **2. Intestinal digestion** The digestion of proteins is further carried out in the intestines by the action of proteolytic enzymes (trypsin, chymotrypsin and peptidase) present in pancreatic and intestinal juices. The polypeptides produced by gastric digestion are hydrolysed to free amino acids by the above enzymes. The amino acids are absorbed in the small intestine and enter the blood circulation through the portal vein. **Metabolism of protein** **1. Breakdown and synthesis of tissue proteins** Recent studies have shown that breakdown and synthesis of tissue proteins proceed simultaneously. A part of the tissue protein broken down continuously is replaced by the formation of new tissue proteins from the amino acids supplied by the diet. **2. Nitrogen balance** When a subject is on a protein free diet, the tissue proteins are broken down and the resulting amino acids are formed. When the nitrogen intake equals the nitrogen lost from the body through urine and faces, the body is said to be in a state of nitrogen equilibrium. When the nitrogen lost from the body is less than that of the nitrogen intake, the body is in 'positive' nitrogen balance. In this case the nitrogen is retained to form new tissues, as for example during growth of the body, if the nitrogen lost from the body is higher than the nitrogen intake, the body is said to be in the 'negative nitrogen balance'. Under the above conditions the body proteins are slowly depleted. Negative nitrogen balances occur under nutrition, fever, starvation etc. oxidized and the nitrogen is excreted in urine. **3. Oxidation of amino acids** The amino acids not utilized for the formation of tissue proteins are oxidised by enzymes in the liver. The ammonia thus formed is converted into urea in the liver and excreted in the urine. The keto acids are oxidized to yield energy.	(4)
Q. 11.	Answer in one sentence	(8)
i.	*Lactobacillus bulgaricus* and *Streptococcus thermophilus*	(1)
ii.	Nicolas Appert	(1)
iii.	Severe malnutrition, inadequate energy intake and energy deficiency	(1)
iv.	180 mg/100 ml of blood	(1)

v.	Low protein diet	(1)
vi.	Beta carotene	(1)
vii.	Vitamin A and Vitamin D	(1)
viii.	Hyderabad	(1)
Q. 12	Define the following terms	(8)
i.	Health - It is a state of complete physical, mental, and social well being, not merely the absence of disease or infirmity.	(1)
ii.	Flavour - Flavor is the sensation produced by a material taken in the mouth, perceived principally by the senses of taste and smell, and also by the general pain, tactile and temperature receptors in the mouth.	(1)
iii.	Food microbiology - Food microbiology is the study of the microorganisms that inhibit, create, or contaminate food.	(1)
iv.	Food additives - A food additive is a substance or mixture of substances, other than the basic food stuff, which is present in food as a result of any aspect of a production, processing, storage or packaging.	(1)
v.	Recommended dietary allowance - It is defined as the quantity of a nutrient present in the diet which satisfies the daily requirement of nearly all individuals in a population.	(1)
vi.	Energy metabolism - Energy metabolism can be defined as the processes that deals with food intake, burning the food to release energy, and storing the excess for the time of energy shortage.	(1)
vii.	Menu planning - Menu planning is the process of planning and scheduling intake of meals for general or specific individual requirements.	(1)
viii.	Food bioprocessing - Food bioprocessing is a green technology that offers an alternative means of food and food ingredient extraction, purification and production using processes that involve the application of enzymes and/or microorganisms.	(1)