GRADIENT IAS

Sample Test Paper of Ankita Dutta (ACS)
from our previous APSC Mains Test Series

Ankita Dutta
(ACS, Rank 70, APSC CCE 2018)

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Schedule
APSC MAINS TEST SERIES

13/ 11/ 2021	Saturday	SET 1		General Studies I		General Studies II
20/ 11/ 2021	Saturday	SET 1		General Studies III		General Studies IV
27/11/2021	Saturday	SET 1		General Studies V		Essay
3/12/2021	MODEL ANSWERS of GS SET 1 released. Essay excluded					
4/12/2021	Saturday	SET 2		General Studies I		General Studies II
11/12/2021	Saturday	SET 2		General Studies III		General Studies IV
18/12/2021	Saturday	SET 2		General Studies V		Essay
24/12/2021	MODEL ANSWERS of GS SET 2 released. Essay excluded					
25/12/2021	Saturday	SET 3		General Studies I		General Studies II
1/1/2022	Saturday	SET 3		General Studies III		General Studies IV
8/1/2022	Saturday	SET 3		General Studies V		Essay
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Attempt between 13th Nov & 20th Jan

18 Mock Tests

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Following is ANKITA DUTTA's (ACS 70, APSC CCE 2018) offline test submission of MOCK TEST NO 4 from our previous APSC MAINS TEST SERIES (old syllabus)

Don't forget to check our MODEL ANSWERS of TEST NO 4 at the end

GRADIENT IAS

EMPOWERING NORTH-EAST INDIA

APSC CCE 2018 Mains Mock Test - 4

Category – General Studies (Sc & Tech and Indian Geography)

Total Marks – 300

Time Allowed – 3 Hours

Important Instructions to Candidates -

1. **Write your Name, Email ID and Mobile Number in the first page of the answer sheet.**
2. **Use both sides of the page to answer**
3. **Leave around ½ inch gap from the edges of the page while writing the answers. Alternately we encourage you to draw margins**
4. **Write the answer according to the word limit and page restriction. Your answer will not be evaluated if you do not follow the word limit or the page restriction mentioned in the particular question**

The figures in the margin indicate full marks for the question

Question No 1 – Answer the following questions in around 200 words and within three pages for each question
(Answers exceeding 250 words or more than three pages would not be evaluated)
(16 X 10 = 160 marks)

I. What is Mitochondrial Replacement Therapy? Discuss its potential in reducing genetic disorders. Also, list various issues around its use in fertility medicine. (4+6+6)
II. What do you understand by Nanotechnology? What are the applications of Nanotechnology? Describe the salient features of Indian Government's Nano Mission. (4+6+6)
III. The rapid diffusion of Artificial Intelligence begets unique opportunities and challenges for India. Discuss. What can be done to address these challenges? (8+8)
IV. Describe the salient features of Indian agriculture. Delineate the major rice producing belt of India. (8+8)
V. How do Indian Monsoon originate? How does El Nino affect Indian monsoon? Describe the impact of monsoons on Indian culture and economy with examples. (4+4+8)
VI. What are the main causes of urbanisation? Critically examine the major issues and challenges that India faces due to the increasing trend of urbanisation. (6+10)
VII. Mumbai, Delhi and Kolkata are the three mega cities of the country but the air pollution is much more serious problem in Delhi as compared to the other two. Why is this so? (16)
VIII. Smart cities in India cannot sustain without smart villages. Discuss this statement in the backdrop of rural urban integration. (16)
IX. Present an account of the Indus Water Treaty and examine its ecological, economic and political implications in the context of changing bilateral relations. (16)
X. What is watershed management? Do you think it can play an important role in sustainable development? Discuss. (4+12)

Question No 2 – Answer the following questions in around 100 words and within one and a half pages for each question.
(Answers exceeding 150 words or more than one and a half pages would not be evaluated)
(8 X 5 = 40 marks)

I. What is 3D Printing? Explain its applications. (4+4)
II. What is Kessler Syndrome? Do you think the launch of ASAT has led to the problem of creation of space debris? (4+4)
III. What is cryogenic engine? Discuss its significance in India's space programme. (2+6)
IV. Explain the importance of water resources and means of water conservation. Explain the drought situation prevalent in India and the possible solutions. (4+4)
V. What is the role of remote sensing in the development of natural resources in India? (8)

Question No 3 – Answer the following questions in around 50 words each and within one page for each question.
(Answers exceeding 100 words or more than one page would not be evaluated)
(5 X 8 = 40 marks)

I. What is Astrosat? Describe its features and objectives.
II. Write a note on Aditya L1.
III. Write a note on India-based Neutrino Observatory Project and its significance for India.
IV. What do you understand by Big Data? What are the applications of Big Data?
V. What are biofuels? Briefly describe fourth generation biofuels.
VI. Is river linking project a solution to the water crisis problem in India? Examine.
VII. What are the main causes of conflict over water? Name one on-going inter-state water conflict in India.
VIII. What is disaster management? How can it be helpful in preventing the loss of lives and property in the event of occurrence of any disaster?

Question No 4 – Answer all the following 30 questions within 10 pages with around 3 answers in a single page.
(Answers exceeding the page limit would not be evaluated)
(2 X 30 = 60 marks)

I. Brahmaputra Biodiversity and Biology Boat (B4)
II. GSLV MK III
III. Blue moon
IV. Cloud computing

V. LIGO and its uses.
VI. What is the difference between polar synchronous and geostationary satellite?
VII. Bio ink
VIII. Goldilocks Zone
IX. Pratyush and Mihir
X. 5G
XI. DNA fingerprinting and its uses
XII. Digital therapeutics
XIII. Free space optical communication technology
XIV. KALAMSAT
XV. What is social forestry
XVI. What is meant by Water Divide?
XVII. Name 4 rabi crops
XVIII. Mention two geographic requirements for the growth of cotton in India.
XIX. Name the two countries having international boundary with the states of North-East India.
XX. How has climate change affected the production of tea in Assam?
XXI. Clean Ganga Mission
XXII. LED Bulb
XXIII. Name of Brahmaputra in its upper course and lower course
XXIV. Seismograph and its application
XXV. Horse latitude
XXVI. Black soil zone of India
XXVII. Which is the largest fresh water lake in India? Where is it located?
XXVIII. Organic farming
XXIX. Two renewable energy sources of India
XXX. Biodiesel and its uses

APSC CCE - 2018 (Mains)

Mock Test - IV

General Studies (Science & Technology and Indian Geography)

Submitted by - Ankita Dutta

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Ans 1) i) Mitochondrial Replacement Therapy (MRT)

a) It is a medical technique in which defective mitochondria carried by a woman is replaced with the healthy mitochondria of a donor

b) Through the in vitro fertilization technique (IVF) the egg is then fertilized with the partner's sperm. Thus the embryo remains free from any such defects

c) Two most common techniques of MRT are → Maternal Spindle Transfer and Pronuclear Transfer

d) This technique prevents the transmission of Mitochondrial (genetic) disease from one generation to the next

Potential of MRT in reducing Genetic disorders

(not attempted)

Issues around the use of MRT —

1) The technique itself does not gurantee the complete removal of "Faulty Mitochondria".

2) The extent of mutation and frequency of division of faulty mitochondria depends on the kind of disease. If these faulty mitochondria find their way into the embryo it will tip off the balance between healthy and faulty mitochondria and the disease may still continue in the subsequent generations.

3) Third, there may also be a risk of mismatch between the mt DNA haplotype of the surrogate and the donor mother.

4) Ethical Issues — The safety of this technique is yet not established even though no adverse effect is seen in the future generations. Many religious groups also believe that this is yet another example of human's meddling with the natural life processes

5) Legal Issues — Legal issues much more complicated as the child formed has genetic content from three different parents.

6) Social Issues — Since technique being expensive have been argued to benefit certain economically forward social groups

Ans 1) ii) Nanotechnology →

① Nanotechnology is a manipulation of matter on an atomic, molecular and supramolecular scale.

② Nanotechnology is a science and engineering conducted at the nanometer size particles like atoms

③ Father of Nanotechnology is Physicist Richard Feyman

Applications of Nanotechnology →

① Nanotechnology can be used to purify drinking water such as AMRIT (Arsenic and Metal Removal through Indian Technology)

② Medical and Healthcare – nanomedicine – a new field that combines nanotechnology with medicine to boost human health care such as nanotech detector for heart attack, nanochips to check plaque etc

③ Electronics – Nano RAM is a type of non volatile random access memory. ~~based~~

3) Energy - Solar Paints also known as Photovoltaic paint is a paint that can be applied ~~on~~ to any surface that will capture energy from the sun and transform it into electricity.

4) Wind Power - Nanogenerators are thin flexible sheets - and when bent, these sheets result in generation of potential power

5) Agriculture and Food - Nanofertilizers are used to regulate the release of nutrients depending on the requirements of the crops

6) Nanobatteries - The North Carolina University researchers have created a new flexible nano scaffold for rechargeable lithium ion batteries that make cell phone battery last longer.

Features of Govt. of India's Nano Mission

① The Nano Mission is a successor of Nano Science and Technology Initiative which was launched in 2001 by Department of Science and Technology

2) Today India has emerged 6th worldwide in terms of scientific publications

3) Nano Mission has been structured in a manner to achieve synergy between the national research efforts of various agencies in this field and launch new programmes in a concerted fashion

4) Objectives of Nano Mission — include basic research promotion, infrastructure development, human resource development etc.

5) Nano Mission is also aiming for development of products and processes for national development specially in the area of ~~drin~~ safe drinking ~~area~~, water, materials development, sensors development etc.

6) An active research community of about 1000 researchers has emerged and a large no of man power is getting prime attention in research

Ans 1)iii) Challenges met by India due to Artificial Intelligence

① Unclear privacy, security and ethical regulations

② Unattractive Intellectual Property regime to incentivize research and adoption of AI.

③ India is also hit by the global AI wave which is beginning to uproot workers from their jobs. A recent study by McKinsey and Company 2014 estimates that 6-8 million workers" currently employed in routine clerical, customer service, and sales could by affected by advancements in machine learning and natural language interface (speech recognition).

④ Reinforcing Social Discrimination - Caste system continues to perpetuate discrimination in modern times in terms of wages too, employment. With the advent of AI has become a growing concern that data driven algorithms are biased. A study of Banerjee (2009) found evidence of caste based discrimination in call centre job applications

(5) Amplifying gender inequality - While internet users increase in rural India through use of mobile phone it - unwittingly amplifies gender inequality. Women in South Asia are 38% less likely to own a mobile than men.

(6) Excluding the disadvantaged through targeting -

Expensive AI based applications may mean that the initial impetus will come from private corporations.

Measures to address challenges →

1) For AI to be effective, it needs access to relevant data in the digital domain. The Digital India is a ~~hole~~ welcome step in this domain.

2) In addition to public data from governmental departments, it would also be useful to create locally relevant public open sets pertaining to language, health, crops, marketplaces and so on

3) AI based solutions need to address broader section of people women, linguistic minorities etc.

4) An improved infrastructure for AI will help growth of start ups

5) In the pace with the growth of AI, India health also have to evolve regulatory mechanism such as safety and quality standards; legal framework addressing data security, privacy and liabilities and ethics review committees

Ans 1) iv) Features of Indian Agriculture —

1) India is an agricultural economy where 49% of the people depend on agriculture

2) Subsistence Type agriculture dependent on unreliable monsoon (60%)

3) India's vast relief, varying climate and soil conditions produce a variety of crops

4) Share in GDP - 14% and net sown area still accounts for about 47% of the total cultivable area of India.

5) Main source of raw materials to the agro based industries viz sugar, Textile, edible oil etc

6) Accounts for 35% of our national income.

7) India provides market for many agricultural funished products

8) Predominance of food crop → 2/3rd of total cropped area. and India is the largest producer and exporter of spices, Millets, Pulses Dry bean, Ginger

9) There are 3 cropping seasons - Rabi, Kharif, Zaid

Major rice producing belt

① West Bengal ranks no 1 with a total rice production of 146.05 lakh tonnes which makes it the highest rice producing state in India with a yield of 2100 kgs per hectare.

② Uttar Pradesh – ranks 2nd with 140.22 lakh tonnes of rice production

③ Andhra Pradesh produces 128.95 lakh tons of rice in India with a production of 12% of total rice produced in the country

④ Punjab comes at the 4th position with a total production of 105.42 lakh tonnes.

⑤ Tamil Nadu ranks 5th with a production of 74.58 lakh ton of rice

⑥ Bihar is on the 6th rank with total production of 71.62 lakh tonnes.

⑦ Chattisgarh – ranks 7th with a rice production of 60.21 lakh tons

⑧ Odisha & Assam ranks 8th and 9th with a total production of 5% of total rice and 45.16 lakh tons respectively

Ans 1) V) India has a tropical monsoon climate. Indian Monsoons rely heavily on the role of

1) Himalayas and Tibetan plateau as a physical barrier and a source of high level heat

2) Circulation of upper jet streams in the troposphere

3) Existence of upper air circum polar whirl over north and south poles in the troposphere

4) The occurence of ENSO (El-Niño and Southern Oscillation) in the South Pacific Ocean

5) Walker cell in the Indian Ocean

6) Indian Ocean Dipole

El Nino's effect on Indian Monsoons

(1) El Nino is a natural phenomenon wherein the ocean temperatures rise especially in parts of the Pacific Ocean (2) It is referred to for a periodic development along the coast of Peru on Indian subcontinent, El Nino during winter result in development of warm conditions (3) During summer, it leads to dry conditions and deficient monsoons (4) In the recent past, India experienced deficient rainfall during El Nino years of 2002 and 2009 whereas

monsoon was normal during El Niño years 1994 and 1997. This so implies that in about 50% of the years with El Niño during summer, India experienced drought during monsoon.

Impact of Monsoon on Indian Economy.

(1) Impact on Indian Agriculture – Agriculture being the backbone of Indian Economy with 61.5% population ~~of 1300 million Indian~~ dependent on agriculture which share 15% of Indian Gross Domestic Product. Indian agriculture is heavily dependent on monsoon. There is a long chain of ill effects if we have poor rainfall – Price of goods increases → ~~Source of~~ Because of low productivity, products of industry do not find a market and the supply of raw materials to industries also suffers

(2) Impact on GDP – Agriculture contributes 15% GDP and if monsoon fails then will reduce % from overall GDP thus ~~has~~ having a detrimental effect on demand in the non agricultural sector

(3) Impact on Balance of Trade – Failure of monsoon affects unfavourably the volumes and balance of India's foreign trade. Revenue of govt. sharply decline due to fall in national income

(4) Impact on Hydro Power Sector

Most of the Indian power projects installed on the Perennial rivers. If monsoon fails it would lower water levels and have detrimental effect on power generation.

(5) Impact on Irrigation —

Agriculture in India is heavily dependent on Indian Monsoons and as such poor rainfall will lead to irrigation problems.

(6) Impact on Culture - Monsoons affect Indian culture in an indirect way. For eg :- Muga silk which unique to Assam (India) throughout the world, is the product of silkworm Antheraea. The larvae of these moths feed on Som and Sualu leaves. Som and Sualu trees heavily depend on monsoons. The Assam Muga silk has cultural implications like it is used during the Bihu festival of Assam.

Ans 1) vi) Causes of urbanisation —

① Industrial revolution - Industrial employment catches the attention of people from rural to urban areas. The old agricultural economics is changing to a new non - agricultural economy. This is a trend which will build a new modern society (Gupter 1997)

② Emergence of large manufacturing centres

③ Job opportunities -

④ Availability of transportation - Due to easy transport people prefer to stay in big cities

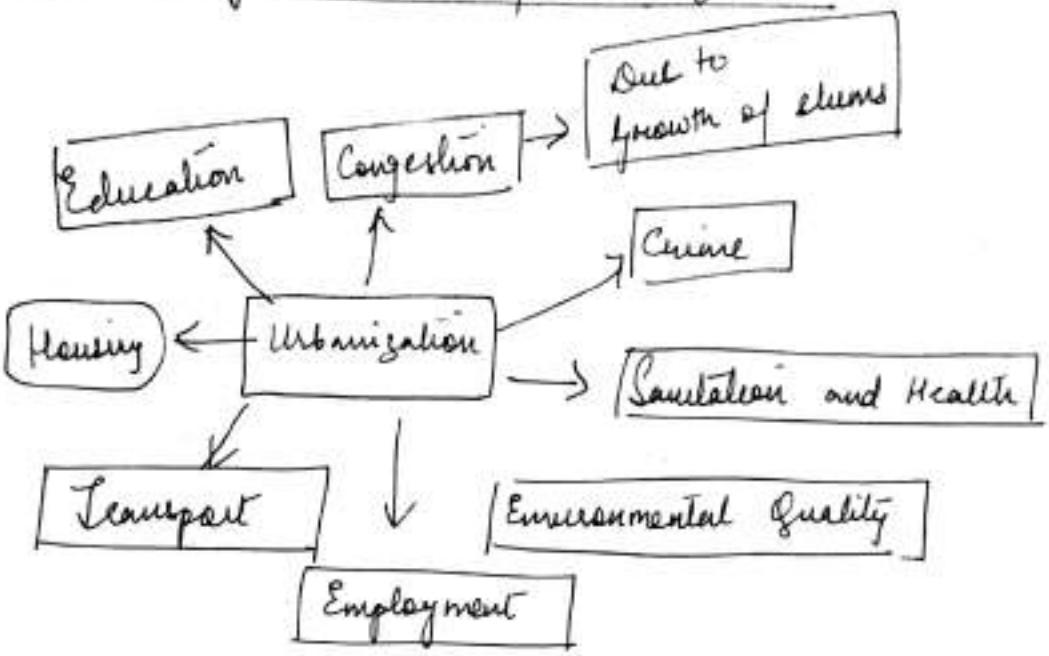
⑤ Migration is the main cause for rapid growth of cities. Combination of many push and pull factors like urban - urban migration or rural urban migration that force people to migrate to cities (Gupter 1997)

⑥ Infrastructure facilities in the urban areas and growth of private sector after 1990.

Issues faced by India due to rapid urbanisation trend

over 34% of India's current population lives in urban areas, rising by 3% since 2011. By some estimates India's urban population could increase to 814 million by 2050.

Problems due to rapid rate of urbanization



① Urban Crimes – Causes of urban crimes increases.

It is often established by many researches that children of broken families living in slums indulge in drugs leading to cases of juvenile delinquency. Poverty related crimes are more prevalent in cities of Patna, Darbhanga, Gaya and Munger

② Water borne diseases – Due to growth of slums many water locked areas are there for which people often suffer and die ~~due to~~ because of dengue, malaria etc. with 14.25 billion Indians, are still at risk of malaria in 2018. even though it India has reduced 3 millions cases since 2016.

Sources of malaria is contaminated water

③ Air Pollution – Delhi has been ranked one of the top most cities in terms of air pollution in the world. As per Central Pollution Control Board, (August 2016), 41 Indian metros faced bad air quality in 60% of total days monitored. 42 lakhs premature deaths in 2015 in the world out of which China and India together shared 52% due to long term exposure to fine particulate matter (PM 2.5).

④ Water Scarcity – Uneven distribution of water by regions. In 4 metros (Kolkata, Delhi, Chennai and Mumbai) 90 crore litres of water is thrown out but only 30% is treated.

⑤ Unemployment – Problem of joblessness is serious. Urban employment is estimated at 15 to 25% of the labour force. This percentage is even higher among the educated people. Major causes of urban unemployment are the huge relocation of people from rural to urban areas. National Skill Mission – to train people

⑥.

Ans 1) vii) (a) Delhi has a complex air pollution problem

At least four sectors – industry, transport, biomass and waste burning and dust are substantial contributors to pollution in Delhi – NCR according to analyses led by Centre For Policy Research

(b) Delhi's air is already about 13 times the WHO safe levels Industry sources are a large share (25–43%) of emissions year round.

(c) Transport passenger and freight accounts for 20–30% of emissions year round and is growing rapidly with vehicle ownership

(d) Biomass and waste burning comprise 20–38% and includes crop burning, waste burning, and household kitchen burning. Crop residue burning is highly seasonally specific and peaks in October, IIT Kanpur's study suggests it accounts for 26% of winter emissions

(e) Dust includes both construction dust from within NCR and long-range transport of dust from

the arid surroundings of Delhi and beyond. Dust is a bigger share of emissions in the summer than in winter, TERI's study suggests it accounts for 38% of summer emissions

- Also because Delhi is a landlocked area and the pollution stays in because the wind speed in November is one of the lowest i.e. 5.2 miles per hour compared to the windiest month i.e. May when the average wind speed is 8.4 miles per hour.

Ans 1) viii) Currently 31% of India's population lives in cities carryout about 60% economic activity

Smart Cities focus on improving energy, transport, public health, education, affordable housing waste management using modern technology.
Smart sustainable cities one of the goals of Sustainable Development Goals of the UN.

About 70% of Indian population lives in villages. In recent times, a number of farmer's suicide happened due to crop failure ~~and~~. We do not have any ~~a solution for~~ any second option for employment in rural areas migration cannot solve the rural problems.

The lack of job opportunities in village coupled with less remunerative farming compels village youth to migrate to cities. The long term effects of migration is disastrous like dilution of village culture, reduced land under cultivation, slum development, , pollution, traffic problems, crime and over burdening of civic amenities. Therefore it is natural that for inclusive development, the Government must focus on them

India needs more smart villages because 69% of India lives there.

The top priority should be the creation of opportunities for youth in villages, thereby discouraging migration. Many jobs require computer skills which are now being taken care of by National Skill Mission, and there are Skill centres to impart training to youth. But problem is with the widespread information that is lacking now also no of Skill Centres should be increased. The digitization of post offices, rural banks and IT enabled services provide excellent opportunities.

The benefits of schemes such as crop insurance, soil health card, MSP should reach the target beneficiaries. The govt has undertaken schemes like DBT for targeting beneficiaries. Proper implementation needs to be there for integrating the rural urban facilities.

Digital India and Skill India can empower rural youth to start their own small

business, start-ups after training in machine, gun repair shops, poultry etc. India's crafts thrive in villages especially as cooperative ventures. Pottery metal craft, weaving, jewellery making are special crafts of the rural craftsmen who can be outsourced as a trainer by urban skill training institutes thus sustaining an old art of pottery making, tribal jewellery making and also teaching the new generation.

Thus the current initiatives of the government will help in bridging the gap between rural and urban India but the implementation part is very necessary and important, in the whole development process of making it 'inclusive' in nature

Ans:1)1X) The Indus Water Treaty is a water distribution treaty between India and Pakistan signed on September 19, 1960 by PM Jawaharlal Nehru and Pakistan's President Ayub Khan brokered by World Bank.

① The Indus Waters Treaty deals with seven Indus and its five ~~to~~ tributaries which are classified into 2 categories —

- Eastern Rivers
  - Sutlej
  - Beas
  - Ravi
- Western Rivers
  - Jhelum
  - Chenab
  - Indus

② According to the Treaty, all the waters of Eastern rivers shall be available for unrestricted use in India. India should let unrestricted flow of water from western rivers to Pakistan. It doesn't mean that India can't use the water in western rivers in "non consumptive" needs like irrigation, storage and even for electricity production. The treaty allocates 80% of water from the six river Indus water system to Pakistan.

Ans 1) x) Watershed Management →

(a) Watershed Management is a method employed by the govt. at micro level basically in rain fed areas with prominent role of Panchayat Raj institutions with major objectives including the conservation, upgradation and utilization of natural facilities such as land, water, plant, animal and human resources in a harmonious and integrated manner for comprehensive development of region and nation.

(b) The development of watershed strategy in the global perspective is traced back to the Earth Summit of 1992 with sustainable growth from grass root level

(c) It is the process to protect and improve quantity and quality of water within the watershed area.

d) It is a socio political - ecological entity, which plays crucial role in determining food, social and economical security to local people.

Role of Watershed Management in Sustainable Development

(i) Sustainable Watershed Management - approach of taking water resources management practices

in a holistic fashion - taking into account of the usage behaviour of various sectors and their effects on land and water use that political, economic social technological and environmental considerations.

2) Purpose of sustainable watershed management is to protect land and water resources, habitat supported by resources for future generations, balance future growth while protecting existing

3) Natural Resource Management element of sustainable watershed management may include interventions like reducing soil erosion, increasing water availability, increasing productivity, improve adaptability especially in context of climate change

4) Natural Resource Management of watershed management focuses on scientific and technical understanding of resources and ecology and life supporting capacities of these resources

5)

Ans 2) 1) 3D Printing →

The term 3D Printing covers a variety of processes in which material is joined or solified under computer control to create a three - dimensional object, with material being added together typically layer by layer.

Applications of 3D Printing →

① It is used to manufacture moulds for making jewellery.

② 3D Printing is becoming popular in the customisable gifts industry, with products such as personalised models of art and dolls.

③ Health - Hearing aids have been made using 3D Printing technology.

④ Bio Printers :- Organ printing or body part printing is being printed and some parts being used as implants of actual body parts

⑤ Dentistry Dental Implants are being made on a commercial level using 3D Printing Technology

⑥ Defence and Aerospace. - At present, AM technology in the aerospace and defence sector

is broadly used for prototyping repair of small parts and component manufacturing Eg: The UK Royal Air Force and Navy use AM for repairing spare

⑦ Food: 3D Printing enables fast automated and repeatable processes, freedom in design, as well as allowing large and easy variability of the cooking process which can be customized.

Ans 2) ii) The Kessler syndrome proposed by the NASA scientist Donald J Kessler in 1978, is a scenario in which the density of objects in Low Earth Orbit is high enough that collisions between objects could cause a cascade where each collision generates space debris that increases the likelihood of further collisions.

The Kessler Effect is a possible effect is a possible effect that if one satellite produces debris that hit another satellite, this will create a chain reaction that will obliterate every orbiting object in the Low Earth Orbit and thus creating a thick cloud of white dots travelling at high speed Rockets would no longer be able to reach

space since they risk getting hit by these debris.

India recently successfully test fired an anti satellite missile (ASAT) by shooting down a live satellite. The project named as Mission Shakti was led by the DRDO aimed at strengthening India's overall security. It was made clear that the intent of DRDO's 'Mission Shakti' is to defend India's space assets and not to start an arms race in space. Since the test was done in the lower atmosphere, whatever debris that is generated will decay and fall back into earth within weeks. Mission Shakti does not violate the 1967 Outer Space Treaty of which India is a signatory.

Ans 2) iii) Cryogenic rocket engine is a rocket engine that uses cryogenic fuel or oxidizer, that is, its fuel or oxidizer are gases liquefied and stored at very low temperatures. Notably, these engines were one of the main factors of NASA's success in reaching the Moon by the Saturn V rocket.

Significance of Cryogenic engine in India's space programme.

(1) Cryogenic engines are used in the upper stages of a rocket launch as they provide the maximum thrust to a launch vehicle

(2) In 2017 ISRO successfully ground tested India's largest indigenously developed Cryogenic Upper stage engine for GSLV MK-III

(3) The development of C25 cryogenic stage will provide ISRO capability to launch 4 ton class satellites to in Geosynchronous Transfer Orbit (GTO) an altitude where satellites revolve in sync with Earth's rotation.

(4) The C25 stage is most powerful upper stage developed by ISRO. uses liquid Oxygen and liquid Hydrogen propellant combination.

(5) So far, the cryogenic engine consisting of very complex Technology has been developed only by Russia, US, France, China, Japan and India

(6) The 50 sec test of C25 is a significant milestone in the ISRO's development of indigenous cryogenic propulsion technology.

Ans 2) IV) Importance of Water Resources.

1) 96.5 % of the total volume of world's water is estimated to exist as oceans and only 2.5% as freshwater. Nearly 70% of this freshwater occurs as ice sheets and glaciers in Antarctica, Greenland and the mountainous regions of the world while a little less ~~of~~ than 30% is stored as groundwater in the world's aquifers

2) India receives nearly 4% of the global precipitation and ranks 133 in the world in terms of water availibility per person per annum.

3) Total renewable water resources of India are estimated at 1897 sq km and by 2025 it is predicted that large parts of India will join countries or regions having absolute water scarcity.

Means of water conservation.

(1) Historically, records show that from ancient times we have been building hydraulic structures like dams, reservoirs, lakes, canals, embankments etc.

(2) Water harvesting is a method of saving surface runoff.

3) The canals used for irrigating field should be properly lined to minimise losses by water seepage.

4) Sprinklers effectively irrigate the area by reducing water losses through seepage and evaporation

5) In dry regions with high rates of evaporation, drip irrigation or trickle irrigation is very useful

6) Rain water harvesting - process of collecting water from roof top and directing it to an appropriate location

Drought situation in India

Drought in India has resulted in lots of millions of deaths over the course of 18th, 19th and 20th centuries. Indian agriculture being heavily dependent on monsoons is critical for irrigation of food crops. Major drought prone areas are - Maharashtra (crop failure leads to highest % of farmers' suicide in the country), Karnataka, (Odisha, Gujarat)

El Nino Southern Oscillation related droughts been implicated in periodic declines in Indian agricultural output

Solution —

55% of the country is chronically drought prone — Need for preparedness to face drought is of paramount importance

(a) Rainwater harvesting

(b) Judicious use of water, revival, restoration and maintenance of existing water bodies.

(c) Construction of new water bodies ~~and~~

(d) Removal of silt from water channels

(e) Creation of Check Dams and other means to curb run off

(f) Underground Storage - best method in hot & arid zones where evaporation is high

(g) Watershed management

Ans 2) v) Role of Remote Sensing in the development of natural resources in India.

Data from Indian Remote Sensing satellites are used for various applications of resources survey and management under the National Natural Resources Management System (NNRMS) in following:

1) Pre-harvest crop area and production estimation of major crops
2) Drought / irrigation monitoring and assessment based on vegetation condition
3) Flood risk zone mapping and flood damage assessment
4) Hydro-geomorphologic maps for locating underground water resources for drilling well
5) Snow melt run off estimates for planning water use in down stream projects
6) Land use and Land cover mapping
7) Forest survey
8) Mineral prospecting.

Ans 3) i) Astrosat is India's first dedicated multi-wavelength space observatory. It was launched on a PSLV-XL on 28 September 2015.

Features →

① One of the unique features of Astrosat mission is that it enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite.

② Astrosat with a lift off mass of 1515 kg was launched on September 28, 2015 into a 650 km orbit inclined at an angle of 6 deg to the equator by PSLV-C30 from Satish Dhawan Space Centre, Sriharikota.

Objectives: →

① To understand high energy processes in binary star system containing neutron stars and black holes

② Estimate magnetic fields of neutron stars

③ Detect new briefly bright X-ray sources in the sky.

Ans 3) ii) Aditya L1 -

(1) The Aditya - 1 mission was conceived as a 400kg class satellite carrying one payload, the Visible Emission Line Coronagraph (VELC) and was planned to launch in a 800km low earth orbit

(2) A satellite placed in the halo orbit around the Lagrangian point 1 (L1) of the Sun Earth system has the major advantage of continuously viewing the Sun without any occultation / eclipse.

(3) Aditya L1 with additional experiments can now provide observations of Sun's photosphere (soft and hard X ray), Chromosphere (UV) and corona (Visible and NIR)

(4) Particle Payloads will study the particle flux emanating from the Sun and reaching the L1 orbit and the magnetometer payload will measure the variation in magnetic field strength at the halo orbit around L1.

(5) Aditya L1 project will enable a comprehensive understanding of the dynamic processes of the Sun and addresses some problems in solar physics

Ans(3) III) India based Neutrino Observatory Project and its significance

① The India based Neutrino Observatory (INO) Project is a multi-institutional effort aimed at building a world class underground laboratory with a rock cover of approx. 1200 m for non accelerator based high energy and nuclear physics research in India

② The goal of **INO** is to study neutrinos. Neutrinos are fundamental particles belonging to the lepton family.

③ Development of detector technology and its varied applications is an important aspect of the project

④ The project includes —

ⓐ construction of an underground laboratory and associated surface facilities ~~at~~ in Tamil Nadu

ⓑ Construction of ICAL detector for studying neutrinos.

ⓒ Setting up of National Centre for High Energy

Physics at Madurai for the operation and maintenance of the underground laboratory, human resource development and detector R & D along its applications.

(5) The detector R & D, electronics and control, magnet design as well as physics studies and numerical simulations related to ICAL detector are being done-in-house at various participating institutions. On a smaller scale the development of human resource has already started in the form of the INO Graduate Training Programme (GTP) under the umbrella of Homi Bhabha National Institute (HBNI) a deemed to be University within DAE

Ans 3) iv) **Big Data** – is structured and unstructured information which need to be processed, organised for better policymaking. Volume, velocity, variety and veracity are often used to determine whether the data is Big Data or not.

Applications of Big Data :→

① Big Data can be used by Defence sector to build a strong security NITI Aayog in an attempt to optimise private business and public goods and services in furthering the idea of India's capability in big data

② Big data can be used in health, weather, wellness, sustainable energy, microelectronics medical devices, clean and green energy, ICT, 3D printing, surgical robots, wind power

③ Big Data Analytics empowers enterprises with real time extraction of data from various sources

④ Financial Institutions, financial matters viz Stocks

investment patterns, risk analysis, environmental modelling, census and population rely on big data

⑤ Big Data is used in the field of education to cater to two specific needs
- Student performance and analysis
- teaching aids and techniques

Ans 3) v) Biofuels are fuels derived from BioMass. They are found in the solid, liquid and gaseous state. Conventional biofuels prepared from sugar or starch eg: Ethanol is the most commonly used fuel in the world prepared by sugarbeet, corn, wheat or potato

Fourth Generation Biofuels →

① The fourth generation biofuels – photosynthetic solar fuels and electrofuels – are expected to bring fundamental breakthroughs in the field of biofuels.

② Technology for production of solar biofuels is an emerging field based on direct conversion of solar energy into fuel using raw materials that are inexhaustible, cheap and widely available.

3) Three category of biofuel do not require the destruction of biomass. This class includes electrofuels and photobiological solar fuels. Some of these fuels are carbon - neutral

4)

Ans 3) VI) The Interlinking of Rivers Programme seeks to transfer water from surplus areas to deficit areas in the country. The ILR seeks to deliver 173 billion cubic metres of water through a 12500 km of canal network to irrigate 34 million hectares

In 2005, National Water Development Agency (NWDA) has included the intra-state rivers linking as the third component in the NPP.

Arguments in favour of Interlinking of Rivers

(1) The country receives most of its annual rainfall during the four monsoon months of June ~~of~~ to September, while the quantum of rain varies widely across different regions. If interlinking of rivers is implemented by connecting through canals, then such uneven water

flow in different river basins will get balanced.

2) Floods are a recurring feature, particularly in large parts of the Ganga - Brahmaputra Meghna basin affecting Assam, Bihar, West Bengal, Uttar Pradesh. On the other extreme, a number of western and peninsular states such as Rajasthan, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu face recurring droughts. NRLP will transfer excess water from flood ravaged states to water - scarce regions. By this, it will provide irrigation to about 35 million hectares in water scarce western and peninsular regions.

Arguments Against Interlinking of Rivers :→

① Loss of biodiversity and forests downstream of a donor river will occur.

② Regime of rivers pairs like Ken-Betwa and Godavari Krishna are almost same as they receive rainfall at same time and flow through similar region. Thus if one is dry or flooded then at the same time other will also be. Hence, interlinking of such rivers is not intelligent. ~~For instance, the Marathwada region in Maharashtra belongs to the Godavari basin~~

Ans 3) VII) Main causes of conflict over water —

1) Low rainfall, inadequate water supply, and dependency on one major water source
2) High population growth and rapid urbanization.
3) Modernization and industrialization.
4) A history of armed combat and poor relations between countries and among groups

Cauvery Water Dispute is one major inter-state water dispute in India.

Ans 3) VIII) Disaster Management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters.

Ways disaster management can help prevent loss of lives during disaster.

① The Union Home Minister with the support of UNDP have prepared a National Disaster Risk Index

for India - this would help map hazards and vulnerabilities across 640 districts and all states including UTs..

(2) Rehabilitation and Reconstruction of assets

(3) Response ~~and~~ of a disaster in a timely manner.

(4) minimum requirements to be provided by the NMDA in the relief camps in relation to shelter, food, drinking water, medical cover and sanitation

(8)

Ans 4) i) Brahmaputra Biodiversity and Biology Boat (B4)

B4 on the Brahmaputra River, a major ecology hotspot in NER, in collaboration with DoNER, B4 will establish a large barge on the River with a well equipped laboratory for analysis of all components of the entire eco system of the River and surroundings. The B4 will link to all the local research institutions along the River as well as national and international laboratories.

Ans 4) ii) GSLV MK III – is a three stage heavy lift launch vehicle developed by ISRO. The vehicle has two solid strap ons, a core liquid booster and a cryogenic upper stage. It is designed to carry 4 ton class of satellites into Geosynchronous Transfer Orbit or about 10 tonne to Low Earth Orbit which is about twice the capability of GSLV MK II.

Ans 4) iii) Blue Moon – is an additional full moon that appears in a subdivision of a year: either the third of four full moons in a season, or second full moon in a month of the common calendar. The meaning is nothing related to the colour but literally may mean "blue tinge) may occur in certain atmospheric conditions.

Ans 4) IV) Cloud computing – As per the National Institute of Standards and Technology (NIST) of the US Department of Commerce, ~~as~~ cloud computing is defined as a model for enabling ubiquitous convenient, on demand ~~to~~ network access to a shared pool of configurable computing resources.

Ans 4) V) LIGO and its uses – The Laser Interferometer ~~an~~ Gravitational Wave Observatory (LIGO) is a facility dedicated to the detection of cosmic gravitational waves and the measurement of these waves for scientific research.

~~Its~~ purpose – To detect cosmic gravitational waves and to develop gravitational wave observations as an astronomic tool.

Ans 4) VI) Difference between Polar Synchronous and Geostationary satellite

Polar Synchronous	Geostationary satellite
1)	1)

Ans 4) vii) Bio ink. - Scientists have developed a new stem cell containing bio ink that allows 3D printing of complex living tissue that may be used for surgical implants. The medical breakthrough was achieved by scientists from the University of Bristol, England.

Ans 4) viii) Goldilocks Zone - refers to the habitable zone around a star where the Temperature is just right - not too hot and not too cold for liquid water to exist on an planet. Goldilocks Zone is a way that allows scientist to hone in their search for Earth like planets that could contain life. In 2013, astronomers reported, based on Kepler Space mission data, that there could be as many as 40 billion Earth sized planets orbiting in the habitable zones of Sun like stars and red dwarfs in the Milky Way.

Ans 4) ix) Pratyush and Mihir - are supercomputers established at Indian Institute of Tropical Meteorology, Pune and National Centre for Medium Range Weather Forecast, Noida respectively

Ans 4)x) 5G - South Korea launched the world's first nationwide 5G mobile network on 3rd April 2019 which will provide smartphones with ~~in~~ near instantaneous connectivity, 20 times faster than 4G.

Ans 4)XI) DNA fingerprinting and its uses -

DNA fingerprinting is a laboratory technique used to establish a link between biological evidence and a suspect in a criminal investigation. It is also used to establish paternity.

Ans 4)XII) Digital therapeutics - subset of digital health is a health discipline and treatment option that utilizes a digital and often online health technologies to treat a medical or psychological condition relying on behavioural and lifestyle changes usually spurred by a collection of digital impetuses.

Ans 4)XIII) Free space optical communication technology is an optical communication technology that uses light propagating in free space to wirelessly transmit data for telecommunications or computer networking

Ans 4) XIV) KALAMSAT - is the lightest satellite in the world launched by ISRO, is the first student built satellite weighs 1.26 kg only.

Ans 4) XV) Social forestry means the management and protection of forest and afforestation of barren and deforestated lands with the purpose of environmental, social and rural development. The term was developed by the National Commission on Agriculture Government of India in 1976.

Ans 4) XVI) Water Divide - any elevated area, such as a mountain or an upland, which separates two drainage basins is known as water divide, for example, the water divide between the Indus and the Ganga river systems. Ambala is located on this water divide

Ans 4) XVII) Wheat, Barley, Linseed, Mustard are rabi crops.

Ans 4) XVIII) (a) Climate - Cotton needs a black clayey soil with warm climate.

(b) Rainfall ranging from 60-100 cm.

Ans 4) XIX) Bangladesh and Myanmar have international boundary with the North Eastern States of India

Ans 4) XX) Climate change is affecting the cultivation of Assam Tea, with rising temperatures reducing yields and altering the distinctive flavour of Erratic rainfall, high temperature, high carbon dioxide had serious affect on tea plantation. A FAO report called for drought tolerant material as an adaptive measure - as told by the Director of Tocklai Tea Research, Jorhat, India.

Ans 4) XXI) Clean Ganga Mission - implementation wing of National Ganga Council set up in October 2016 under the River Ganga (Rejuvenation, Protection and Management) Authorities order 2016. The aim is to clean the Ganga and its Tributaries.

Ans 4) XXII) LED Bulb is an electric light for use in light fixtures that produces light by using one or more light-emitting diodes. LED lamps have a lifespan many times longer than equivalent incandescent lamps, and are significantly more efficient than most fluorescent lamps.

Ans 4) XXIII) Tsangpo in upper course

Ans 4) XXIV) Seismograph is an instrument for measuring earthquake waves

Ans 4) XXV) Horse Latitude - are subtropical ridges or subtropical highs are the subtropical latitudes between 30 and 35 degrees both north and south Ea where Earth's atmosphere is dominated by subtropical high, an area of high pressure which suppresses precipitation and cloud formation and has variable winds mixed with calm winds.

Ans 4) xxvi) Black soil zone of India is found in Central India - famous as the Deccan Plateau has a majority of black soil favourable for cotton cultivation. This portion consists of mainly Maharashtra and Karnataka including some parts of Gujarat and Madhya Pradesh

Ans 4) xxvii) Wular Lake in Bandipor district in the Indian state of Jammu and Kashmir is the largest fresh water lake in India

Ans 4) xxviii) Organic farming - alternative ~~ag~~ agricultural system which originated in the 20th century involves much more than choosing not to use pesticides, GM food etc, helps in maintaining environment health by reducing the level of pollution. Sikkim has formally become India's first fully organic state ~~state~~ declared in 2016 by PM Modi

Ans 4) xxix) Solar Energy and wind Energy.

Ans 4) xxx) Biodiesel - vegetable oil or animal fat based diesel fuel consisting of long chain alkyl esters

Uses - In Standard Diesel Engines in trucks, buses, cars

GRADIENT IAS

EMPOWERING NORTH-EAST INDIA

MODEL ANSWER SHEET

APSC CCE 2018 Mains Mock Test - 4

Category – General Studies (Science and Technology, Indian Geography

Total Marks – 300

Time Allowed – 3 Hours

Question No 1 (16 marks)

I. **What is Mitochondrial Replacement Therapy? Discuss its potential in reducing genetic disorders. Also, list various issues around its use in fertility medicine. (4+6+6)**

Ans: Mitochondrial replacement therapy (MRT) is a special form of in-vitro fertilization in which the future baby's defective mitochondrial DNA, received from mother having Mitochondrial disease, is replaced by healthy Mitochondrial DNA from a donor woman. Such a baby is called a "Three-Parent Baby" as the technique involves using DNA from three people in order to prevent inherited diseases, from mitochondria that have their own genome.

Potential of MRT

Mitochondrial diseases affect those parts of the body that need most energy, such as, the brain, muscles, heart and liver. Faulty mitochondria have been linked to common medical problems, including Parkinso's disease, deafness, failing eyesight, epilepsy and diabetes. All these can be prevented with this technology.

Further, it saves scientists the arduous task of selecting only infected mitochondria and simplifies the process as whole set of mitochondria can be replaced. MRT can also help in saving children from a neurological condition called Leigh syndrome and Barth syndrome.

Issues and challenges:

- Mitochondrial transfer passes on few genetic changes from one generation to another. That raises ethical concerns because any unexpected problems caused by the procedure could affect people who are not yet born, and so cannot give their consent to have the treatment.
- Mitochondria are not completely understood, and the DNA they hold might affect people's traits in unknown ways.
- Being a germ line technology, MRT crosses an ethical boundary. It may encourage people to produce designer babies.
- Experts have warned that three-parent babies could be at greater risk of cancer and premature ageing, and would need to be monitored all their lives.
- Question of compatibility between the mother's nuclear gene and donor's mitochondrial gene also arises.
- For this procedure, a large number of eggs will be harvested from the donor and the mother. Discarding extra embryos raises an ethical issue.
- This invasive process can be risky for women. Considering these issues, it is imperative that proper research be done to understand the implications of this procedure before legalizing the same.

II. What do you understand by Nanotechnology? What are the applications of Nanotechnology? Describe the salient features of Indian Government's Nano Mission. (4+6+6)

Ans: Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. The physical, chemical and biological properties exhibited by a material changes at this size level is unique and peculiar way, i.e. it follows the laws of quantum physics which is very different from the laws of Newtonian physics we see and feel. As nanotechnology allows manipulation of properties at a very small scale, it can have many applications such as:

- Medical field: nano scale diagnostic devices are more efficient in detecting cancer or infection, nano sized drugs can be delivered to targeted area which can also help fight cancer.
- Combating climate change: by developing nanomaterial which can effectively help to reduce the carbon dioxide in the air and trigger bioremediation to get rid of toxic waste such as dyes, oil spills etc.
- It accelerates biodegradation, to make organic manures or biogas and fertilisers (by the use of iron oxide particles).
- Agriculture: food processing industry can get better packaging, presentation with least waste and minimum moisture flow and growth of bacteria. Also, silver nanoparticles which exhibit antifungal, anti-bacterial, anti-inflammatory, antiviral, antiplatelet properties can be used to increase the shelf life of agricultural products.
- Defence: use in intelligence gathering through difficult to detect sensors/cameras/recording devices, precision guiding tools etc.
- Construction: as nanomolecular structures can make asphalt and concrete more robust to water-seepage, heat-resistant nanomaterials can block ultraviolet and infrared radiation etc.
- Energy: such as novel hydrogen storage systems based on carbon nanotubes and other lightweight nanomaterials, nanocatalysts for hydrogen generation etc.

Salient features of Nano Mission:

- Will target all scientists, institutions and industry in the country
- Strengthen activities into nano science and technology by promoting basic research, human resource development, international collaborations, orchestration of national dialogues and nano applications and technology development

- Make greater efforts to promote application-oriented R&D so that some useful products, processes and technologies also emerge.

III. The rapid diffusion of Artificial Intelligence begets unique opportunities and challenges for India. Discuss. What can be done to address these challenges?

Ans: Artificial Intelligence (AI) is a term used for simulated intelligence in machines, which are programmed to mimic humans in a rational manner to achieve specific goals like visual perception, speech recognition, decision-making, and translation between languages. Due to its diversified application, AI is one of the fastest-growing areas of technology and provides unique opportunities for India such as**:**

- A study by Accenture states that AI could add up to $957 billion dollars to the Indian economy and increase India‟s income by 15% in 2035 by changing the nature of work. AI adoption can make healthcare more reliable, affordable and accessible, thereby, help achieve universal healthcare and improve India‟s prospects in medical tourism.
- It can help augment revenue of businesses through better-targeted offers, reduction of demand-supply mismatch, etc.
- It can improve the efficiency of Indian armed forces in areas like logistics, surveillance etc.

Challenges faced by India regarding AI

- Regulatory challenges for ensuring data security, protection, privacy, and ethical use via enabling frameworks.
- Social disruption: due to impact in areas such as employment concerns, changing preference of an AI empowered middle class, negative social attitude leading to slow adoption of AI etc.
- International competition: Currently, India lags behind USA and China in AI building capabilities mostly due to the lack of large internet companies like Google and Baidu that harness users‟ data.
- Absence of widespread expertise in AI technologies: due to largely out-dated education system and acquiring of obsolete skills.
- Lack of research: due to paucity of funds in both public and private institutions as well as lack of policy support
- Inadequate physical infrastructure such as poor Internet access etc. impedes technology delivery.
- Technological Competence: Strength of Indian Software and IT lies in support services. R&D and skills for core solutions and basic research in AI is still nascent.

Measures to address the challenges include:

- India must formulate a policy to drive AI innovation, adaptation and proliferation in multiple sectors. Data policy should be formulated to establish sharing rights, data ownership, data usage policies etc.
- AI should be a critical component of programmes like Make in India, Skill India, Digital India, etc.
- Human Resource Development: through developing an AI Education strategy and recommending AI based curriculums. This also includes reskilling via identification of skill sets required for AI as well as creating an AI Readiness Index for states.
- Evolving standard guidelines for the design, development and deployment of AI based systems to enhance regulation. Recent developments like the inauguration of Wadhwani Institute of Artificial Intelligence, creation of a Task Force on AI for Economic Transformation by Ministry of Commerce & Industry and signing of Statement of Intent by NITI Aayog and Google to help grow AI ecosystem in India are welcome steps to overcome some of the above challenges.

IV. Describe the salient features of Indian agriculture. Delineate the major rice producing belt of India.

Ans: The salient features of Indian agriculture:

- Subsistence agriculture: Most parts of India have subsistence agriculture. The farmer owns a small piece of land, grows crops with the help of his family members and consumes almost the entire farm produce with little surplus to sell in the market.
- Population pressure: The population in India is increasing at a rapid pace and exerts heavy pressure on agriculture. Agriculture has to provide employment to a large section of work force and has to feed the teeming millions. While looking into the present need of food grains, we require an additional 12-15 million hectares of land to cope with the increasing demands by 2010 A.D. Moreover, there is rising trend in urbanization.
- Importance of animals: Animal force has always played a significant role in agricultural operations such as ploughing, irrigation, threshing and transporting the agricultural products. Complete mechanisation of Indian agriculture is still a distant goal and animals will continue to dominate the agricultural scene in India for several years to come.
- Dependent upon monsoons: Indian agriculture is mainly dependent upon monsoon which is uncertain, unreliable and irregular. In spite of the large scale expansion of irrigation facilities since Independence, only one-third of the

cropped area is provided by perennial irrigation and the remaining two-third of the cropped area has to bear the brunt of the vagaries of the monsoons.

- Variety of crops: India is a vast country with varied types of relief, climate and soil conditions. Therefore, there is a large variety of crops grown in India. Both the tropical and temperate crops are successfully grown in India. Very few countries in the world have a variety of crops comparable to that produced in India.
- Predominance of food crops: Since Indian agriculture has to feed a large population, production of food crops is the first priority of the farmers almost everywhere in the country. More than two-thirds of the total cropped area is devoted to the cultivation of food crops. However, with the change in cropping pattern, the relative share of food crops came down from 76.7 per cent in 1950-51 to 58.8 per cent in 2002-03.
- Insignificant place given to fodder crops: Although India has the largest population of livestock in the world, fodder crops are given a very insignificant place in our cropping pattern. Only four per cent of the reporting area is devoted to permanent pastures and other grazing lands. This is due to pressing demand of land for food crops. The result is that the domestic animals are not properly fed and their productivity is very low compared to international standards.
- Seasonal pattern: india has three major cropping seasons – kharif, rabi, zaid.

The major rice producing belts of India are:

- Gangetic belt: the major states producing rice are –Uttarakhand, West Bengal, Uttar Pradesh, Bihar and Jharkhand.
- Brahmaputra belt: Assam
- Krishna belt: Andhra Pradesh, Maharashtra, Tamil Nadu
- Other states producing rice are: Punjab, Odisha, Chhattisgarh

V. How do Indian Monsoon originate? How does El Nino affect Indian monsoon? Describe the impact of monsoons on Indian culture and economy with examples.

Ans: The pressure and wind conditions over India are unique. These are greatly influenced by the reversal of the direction of wind often termed as monsoon, hence India experiences monsoon type of climate.

Origin and Arrival:

- Generally there is a high pressure over the north of Himalayas so cold winds flow from land to the low pressure oceans. However in summers the low pressure belt develops over the interior Asia(Due to continentality and high temperatures), and winds blows from south west ocean to the land with lot of moisture and hence the rain. This reversal in the direction of the winds are referred as monsoons. In India there are S-W and N-E monsoons based on the direction of the winds.

- The S-W monsoons enter Kerala by early June and by end of June spread to all over the country. The withdrawal begins by mid oct and by early Dec completely withdraws from the country. Also by this time the N-E monsoon are set in motion. The Tamilnadu coast gets more rainfall due to N-E monsoons.

Factors influencing monsoons:

- The differential heating and cooling of land and water creates low pressure on the landmass and high pressure on sea during summers.
- The shift of ITCZ in summer over ganga plain, creates low pressure over northern plains.
- The intensity and position of HP area over east of Madagascar affects Indian monsoon.
- Low pressure over Tibetan plateau during summers, which results in vertical currents and formation of low pressure.
- The movement of westerly jet stream to northern of the Himalayas and the presence of Easterly jet stream over deccan peninsula.
- The changes in the pressure conditions are also affected by ENSO.
  Apart from the above mentioned many more factors effects the monsoon directly and indirectly hence contributing to the complex nature of the Indian monsoons.

Impact of El Nino on Indian monsoons: Generally, El Nino and the Indian Monsoon rains are inversely related. Trade winds coming from South America normally blow westward towards Asia during Southwest Monsoon. Warming of the Pacific Ocean results in weakening of these winds. Therefore, moisture and heat content gets limited and results in reduction and uneven distribution of rainfall across the Indian sub-continent.

The most prominent droughts in India, six of them, since 1871 have been El Nino triggered droughts, including the recent ones that occurred in 2002 and 2009. Nevertheless, it is important to note that all El Nino years do not lead to drought in India. The year 1997-98 is a stark reminder as it was a strong El Nino year but that did not cause drought in India, in fact, rainfall was in excess. On the other hand, a moderate El Nino in 2002 resulted in one of the worst droughts.

Impact of Indian monsoons on culture and economy:

- **Impact on Indian Agriculture:** The agriculture is the backbone of Indian economy because more than 60% of Indian population engaged in agriculture, which shares around 20.5% in the Indian gross domestic product. In India, water is more valuable than gold for the farmers or the one who engaged in agriculture. In case monsoon is favourable then we have a positive impact or if not favourable then then the prices of the goods increases and the services of other classes of people is diminished. Products of industry do not find a ready market and the supply of raw materials to industries also suffers.
- **Impact on GDP (Gross Domestic Product):** If monsoon fails then it will reduce the percentage points from the overall GDP growth of India. This will also have a detrimental effect on demand in the non-agricultural sector.
- **Impact on Balance of Trade**: The balance of trade is also dependent on the unexpected and inexplicable changes in the monsoon as if the monsoon is favourable we have a favourable balance of trade and if the monsoon is not favourable we have a negative balance of trade. The failure of the monsoon affects unfavourably the volumes and the balance of India's foreign trade. The revenue of the government sharply decline due to the fall in the national income and the government is burdened with extra ordinary expenditures. Hence, we can say state's revenue and income depends on the monsoon every year.
- **Impact on the food supply:** If monsoon failed, it will hamper the agricultural production, which would stroke on the food prices.
- **Impact on the hydro-power sector and irrigation facilities:** Most of the Indian power project installed on the Perennial Rivers. If monsoon fails, it would lower the water levels that have detrimental effects on the power generation as well as irrigation facilities.
- **Impact on rural economy:** India's rural life revolving around agriculture and allied activities in small villages, where the overwhelming majority of the population lives. As per the 2001 census, 72.2% of the population live in about 638,000 villages and the remaining 27.8% lives in more than 5,100 towns and over 380 urban agglomerations. The unseasonable and pre-monsoon rain damaged the crops, especially those areas where monsoon rain is adequate, and then it would hit the farm output and affects the rural demand.

VI. What are the main causes of urbanisation? Critically examine the major issues and challenges that India faces due to the increasing trend of urbanisation.

Ans: The term Urbanization means the change from a rural to an urban society which involves an augment in the number of people in urban regions during a particular year. Likewise, Gooden argued urbanization as the immigration of people in huge numbers from rural to urban areas and this process happen due to the concentration of resources and facilities in towns and cities.

Major causes of urbanization are:

- Emergence of large manufacturing centres.
- Job opportunities: There are ample job opportunities in mega cities therefore village people or individuals from town frequently migrate to these areas.
- Availability of transportation: Due to easy transport, people prefer to stay in big cities.
- Migration: Migration is main cause for rapid growth of mega-cities. Migration has been going on over centuries and it is normal phenomenon. When considering urbanization rural-urban and urban-rural and rural-rural migrations are very important. Urban-urban migration means that people move from one city to another. People may move to the city because they are forced by poverty from rural community or they may be pulled by the magnetism of city lives.
- Infrastructure facilities in the urban areas: Infrastructure has vital role in the process of urbanization in the development of countries. As agriculture becomes more fruitful, cities grow by absorbing workforce from rural areas. Industry and services increase and generate higher value-added jobs, and this led to economic growth. The geographic concentration of productive activities in cities creates agglomeration economies, which further raises productivity and growth. The augments income and demand for agricultural products in cities.
- Growth of private sector.

Challenges:

- Degradation of environmental quality: Due to urbanization, there is environmental degradation especially in the quality of water, air and noise. With the influx of more people in cities, there is great demand of facilities such as housing. Some unlawful factories and even houses which have a poor infrastructure, the waste from buildings are directly channelled to the nearest river or water resources which directly pollute the water. The domestic waste,

industrial effluents and other wastes that were dumped directly to the river, degrade the water quality. Another after effects of rapid urbanization is the air pollution which has also increased due to emanation from motor vehicles, industrial development and use of non-environmental friendly fuel sources.

- Decline in quality of living for urban dwellers: Urbanization is major concern for management researchers because it decline in quality of living for urban inhabitants. As the metropolis becomes a developed city, the land value will also increase. The housing provision will focus more to fulfil the needs of the high income group. As such, there will be a problem in the provision of housing, especially for the middle and low class people. The supply of housing for the urban poor is still inadequate as the cost of these houses is very high to which low and middle income group cannot afford. The lack of housing provision for the low income group has led to the continuation of unlawful resident settlements in the city. These unlawful tenant settlements will certainly lack in proper infrastructure that will bring about many hindrances to the urban environment and create social problems such as child education, crime, drugs, delinquency and others. Besides housing problem for low income group, the process of urbanization has also increased the demand on infrastructure and utility which cannot be fulfilled from the existing facilities.
- Unsuccessful urban governance: The urban authority undergoes with multifaceted challenges to manage a city. The fast speed of urbanization is major challenges which need every party to be more focused in undertaking each and every responsibility in urban development. However, the involvement of several agencies and departments in urban management made it complicated to synchronize many actions and resultant, it affects the efficiency of those actions. Besides this, the local authority also deals with the different goals and interests of community groups which they need to fulfil. The local authority also needs to find solution for different social issues.
- Overcrowding, sewerage problems, trash disposal, congestion, higher crime rates, water availability are other challenges.
- Problem of Urban Pollution: Rising urbanisation in present situation led to develop industries and transport systems out of proportion. These developments are mainly responsible for contamination of environment, particularly the urban surroundings. Urban pollution is mainly the collection of impurities created by cities which would certainly shock city dwellers.

Possible solutions:

- The most effectual way to resolve issues of urbanization is to make the economy of village and small scale fully viable. Economies must be revitalized if government undertakes huge rural development program. It is suggested that

surplus manpower must be absorbed in village in order to migrate to urban areas.

- It is needed to control traffic congestion in urban region and people must be encouraged to use public transport. India must improve the traffic control system to avoid accidents.
- Government must make polices to construct low cast multi-storeyed flats in order to accommodate the slum dwellers.
- Government should provide funds to encourage entrepreneurship and also find solution for pollution in the nation.
- The government should not be keen to develop a city without considering the impacts towards the social and environmental aspect. Instead, the government should modify the urban development process in order to accomplish a developed city and make efforts to lessen the possibility of problems that might arise.

VII. Mumbai, Delhi and Kolkata are the three mega cities of the country but the air pollution is much more serious problem in Delhi as compared to the other two. Why is this so?

Ans: The reasons for the pollution problem being so severe in Delhi are:

- Due to the location factor of being away from the coastal regions, so there is no sea breeze which gets away the pollutants as it is happens in Mumbai, Kolkata and Chennai.
- There is agriculture regions of paddy around Delhi i.e. in Punjab and Haryana, where burning of waste during the winter takes place and this travels to the Delhi and in Delhi winters are also very cold, so the atmosphere gets proper medium to the creation of the smog.
- Delhi is surrounded by the industrial towns like Gurgaon and Noida, where factories release a lot pollution, and this pollution directed towards the Delhi.
- Per capita income of Delhi is higher as compared to Mumbai and Kolkata, which makes easier for the people to purchase motor vehicles and this leads to higher vehicle concentration in smaller areas and resulted into the greater vehicular emissions leads to increase in the pollution.
- Delhi is landlocked territory as compared to Mumbai and Kolkata, so the level of pollution is more as the level of particulate matter and pollutants is not able to get discharged in to the surroundings.
- Delhi also has higher area under roads as compared to Mumbai and Kolkata, which results in more road dust and air pollution.
- Delhi's NCR is the largest NCR in the world, so this creates more pressure on its environment.

Thus, the problem of air pollution in Delhi can be attributed to its geographical location as compared to Mumbai and Kolkata. Now Delhi and NCR is enveloped by toxic smog, which forcing the Indian Medical Association (IMA) to declare a public health emergency, advising citizens to stay indoors, and for schools to be shut.

The need of the hour is to devise some mechanisms which can help to bring down the level of pollution in the city such as using less pollution causing vehicles, developing a good mass transit system and controlling waste effluents from industries.

VIII. Smart cities in India cannot sustain without smart villages. Discuss this statement in the backdrop of rural urban integration.

Ans: Currently, 31% of India's population lives in cities; these cities also generate 63% of the nation's economic activity. These numbers are rapidly increasing, with almost half of India's population projected to live in its cities by 2030.

- Smart Cities focus on the most pressing needs and on the greatest opportunities to improve quality of life for residents today and in the future. • Smart cities are generally focus on subjects like Energy, Transport, Public Health, Education, Affordable Housing or Waste Management with the help of modern technology.
- But for the success of smart city mission, rural-urban migration has to be reduced.
- Migration is the major hurdle in development of smart cities because:
    - Migration leads to development of slums which reduces the availability of basic amenities to the people.
    - The large scale migration lead to increase in labor supply and ultimately reduce wage rate which cause people to live with pitiable housing and education facilities.
    - Large epidemics cause by diseases like dengue, malaria etc are indirect result of population explosion in big cities which is mainly caused by migration.
    - It also leads to degradation of environment.

Hence if sufficient basic amenities and facilities shall not be provided in peri-urban and village areas then effective resource system of smart cities might not be able to provide quality of life to people which is the main aim of Smart city mission.

So, there is need to build smart villages with better education, health and employment opportunities to make smart cities sustainable. Dozens of services including construction, farming, electricity, health care, water, retail, manufacturing and logistics are needed in building a smart village. Computing, communication and information

technologies play a major role in design, delivery and monitoring of the services. All the techniques and technologies needed to build a smart village are available now and some of them are being used in villages in India but these are disparate, fragmented and piecemeal efforts. The need of the hour is strategy, integrated planning, and above all monitoring and execution of the activities using appropriate governance models.

IX. Present an account of the Indus Water Treaty and examine its ecological, economic and political implications in the context of changing bilateral relations.

Ans: Indus Waters Treaty (IWT) is a bilateral river-water sharing treaty between India and Pakistan, brokered by World Bank. It was signed by Pt. Nehru and General Ayub Khan in 1960.

According to this treaty, Ravi, Beas and Sutlej, which constitute the eastern rivers, are allocated for use by India before they enter Pakistan. Similarly, Pakistan has rights of the use of western rivers Jhelum, Chenab and Indus.

With the ongoing conflict between India and Pakistan, it has been indicated by India that it can use Indus water as a pressure technique if Pakistan doesn't control the cross border terrorism.There have been suggestions that the treaty is unfair to India as it has been allocated a smaller water share. Further, it is also stated that India underutilises its share of waters from the three western rivers, and that Pakistan is not forthcoming with respect to river data sharing.

However if the treaty is annulled it will have serious ecological, economic and political repercussions.

- Ecologically, construction of dams in India will lead to inundation of large areas. This will force many animal species to migrate. Since most of the species here are very rare, habitat loss can trigger extinction. Formation of lakes will further alter the local ecological balance. Since Himalayas are structurally fragile, it will further increased fragility and may cause local level adjustments, thus causing minor earthquakes, landslide in hilly areas, etc. On the other hand, Pakistani territory will be water starved and species will be affected because of lack of water.
- On the economic front, India will need to invest huge amount of capital for building dams and reserviors to stop flow of the rivers into pakistan.However India will get more water for irrigation, power generation and other purposes.For pakistan,it will create drought like situations and severe decrease in hydro power generation.The agriculture and industries of Pakistan are greatly dependent upon Indus. Water shortage will be a setback to Pakistan's economy.
- Politicaliy, it will further intensify tensions between the two nations and may lead to a full-fledged war. Also current sentiments in Kashmir may result in increased hostility if any relook at the treaty is undertaken.Moreover it can raise

questions about India's commitment on international pacts and treaties. It could further be a jolt to the accomodative nature of India and to her pro-talk attitude. Also China may threaten to block Brahmputra waters.Since Indus starts from Tibet, there is also a possibility of China trying to tinker with its path or causing artificial floods.

Thus while there is an urgent need for some action, but tinkering with the treaty is not only unrequired, but may do more harm than good to the country.

X. What is watershed management? Do you think it can play an important role in sustainable development? Discuss.

Ans: Watershed management basically refers to efficient management and conservation of surface and groundwater resources. It involves prevention of runoff and storage and recharge of groundwater through various methods like percolation tanks, recharge wells, etc. However, in broad sense watershed management includes conservation, regeneration and judicious use of all resources – natural (like land, water, plants and animals) and human with in a watershed. Watershed management aims at bringing about balance between natural resources on the one hand and society on the other. The success of watershed development largely depends upon community participation.

The Central and State Governments have initiated many watershed development and management programmes in the country through people's participation:

1. Haryali is a watershed development project which aims at enabling the rural population to conserve water for drinking, irrigation, fisheries and afforestation.
2. Neeru-Meeru(Water and You) programme (in Andhra Pradesh) - water harvesting structures
3. Arvary Pani Sansad (in Alwar, Rajasthan) - water harvesting structures
4. Tamil Nadu has made water harvesting structures in the houses compulsory.

Watershed development projects in some areas have been successful in rejuvenating environment and economy and through this integrated water resource management approach water availability can be ensured on sustainable basis. Watershed Management is important for sustainable development because of following reasons:

- It checkes soil erosion by contour bunding, check dams, buffer strips, grassed waterways, reestablishment of wetlands.
- Recharging of groundwater done by retention ponds for rain water storage, rain water harvesting, constructing tankas.
- Avoid floods by silt fence, hydroseeding.

- Lessen water pollution by sump cleaning, not using of extra nutrient on agricultural lands.
- Soil fertility conservation by saving it from leaching, silting, asking industries to treat their effluents before disposing them to rivers.

Question No 2 (8 marks)

I. What is 3D Printing? Explain its applications.

Ans: 3D printing is a phrase coined by the media and is often **used to refer to all types of additive manufacturing.** However, **3D printing** is defined as "**fabrication of objects** through the deposition of a material using a print head, nozzle or other printer technology".

Applications:

- Better decision making. 3D print a range of concepts and select the best option during the early design stages
- Check shape and form. 3D printing a basic model makes it easy to assess the shaping, size and overall proportions
- Functional prototyping. Test your prototype in real conditions to check functionality, fit and manufacturability
- Check appearance. Visual appearance can be appraised easily by designers, manufacturers and stakeholders
- For the test of prosthetics, 3D printed solutions could allow for a relatively cheaper option compared to more expensive forms of prosthetics. Many times persons with disabilities from lower income groups are forced to take alternative measures given the high cost of medical care and therapy. The nature of 3D printing is that it is evolving extremely fast to adapt to various needs and there is a comparable market for these requirements. It is not entirely wrong to compare this to the development of the mobile phone and PC markets and its decreasing cost with each iteration in these devices.
- It offers an impressive alternative to the long list of waiting patients on the donor list. Patients waiting for various organ transplants have to follow certain criteria such as matching blood groups. With 3D printing, a patient's conditions can be adopted to suit the modeling of an organ.
- For burn victims, 3D printing is beginning to offer a unique combination of bio-printing that offer skin like texture to printed skin that can be grafted on to the patient.

- 3D printing is used to manufacture moulds for making jewelry, and even the jewelry itself. 3D printing is becoming popular in the customisable giftsindustry, with products such as personalized models of art and dolls, in many shapes: in metal or plastic, or as consumable art, such as 3D printed chocolate.

II. What is Kessler Syndrome? Do you think the launch of ASAT has led to the problem of creation of space debris?

Ans: More than 5 decades of human space exploration since the first Soviet-launched Sputnik satellite in 1957 has produced a hazardous belt of orbiting debris in the space. There are estimated to be more than 100 million pieces circling our planet in the lower orbit, posing a growing threat to future space exploration. These pieces of debris travel at high speeds. A relatively small piece of orbital debris can inflict a great deal of damage on satellites or spacecraft orbiting in the space.

This phenomenon is Kessler Syndrome which describes a self-sustaining cascading collision of space debris in low earth Orbit. It may render space eventually inoperable for important space services like navigation, weather forecasting, communications etc.

Potential threats:

- Threat to space crafts and international space stations.
- There are strong chances of their collission with earth.

There were immense international concerns regarding ASAT generating significant amount of space debris. However, the Indian government has reiterated that none of the international treaties or agreements technically prohibits the kind of test that India presently carried. The Indian test was done in the lower atmosphere to ensure that there was no space debris. So, whatever debris is generated will decay and fall back on Earth within weeks.

III. What is cryogenic engine? Discuss its significance in India's space programme.

Ans: Cryogenic technology involves the use of rocket propellants at extremely low temperatures. The combination of liquid oxygen and liquid hydrogen offers the highest energy efficiency for rocket engines that need to produce large amounts of thrust

A Cryogenic rocket stage is more efficient and provides more thrust for every kilogram of propellant it burns compared to solid and earth-storable liquid propellant rocket stages. Specific impulse (a measure of the efficiency) achievable with cryogenic propellants (liquid Hydrogen and liquid Oxygen) is much higher compared to earth storable liquid and solid propellants, giving it a substantial payload advantage.

However, cryogenic stage is technically a very complex system compared to solid or earth-storable liquid propellant stages due to its use of propellants at extremely low temperatures and the associated thermal and structural problems.

Significance for India's space programme:

- India is only the 6th country to develop the cryogenic engine after the USA, France, Japan, China and Russia.
- It is important technology for India because India could launch heavy satellites (of weight more than 2500-3000kg) with the help of Cryogenic engines and its critical for the success of GSLV program.
- The technology also holds importance in the context that India was denied this technology in 1990s by the USA when India was making deal with Russian agency to transfer of technology.
- With this technology India does not have to depend on the other space agencies.
- It will not just help ISRO probe deeper into space but will also bring it extra revenue, enabling it to make commercial launches of heavier satellites. By providing the cost effective and reliable services India can tap the Asian and African space markets, which are looking towards India on this front.

IV. Explain the importance of water resources and means of water conservation. Explain the drought situation prevalent in India and the possible solutions.

Ans: The importance of water resources:

- The supply-demand gap for water is projected to rise to about 50% by 2030, with demands doubling from current levels of 700 billions cubic meters to around 1498 billion cubic meters, and supply barely reaching 744 billion cubic meters.
- The average annual rainfall in the country has been estimated about 1170 millimeters (mm). This, along with the, total snowfall and glacier melt in terms of Volume works out to about 4000 bil1ion cubic meters (bcm). However due to losses through evaporation and evapo-transpiration, the water availability in the country has been assessed to be about 1869 bcm.
- Only about 62 million hectare (mha) or about 44% of the cropped area in the country is reporteed as irrigated
- Drinking water needs are on the increase due to increase in population
- India is endowed with estimated hydropower potential of more. Than 1500 mega watts. However, only about 21 % of the potential been developed so far and a further 10% being developed.

Means of water conservation:

- Using water efficient sanitary means like EcoSan toilets and bio toilets
- Contour farming
- Artificial recharge
- Catchment area protection
- Inter basin water transfer
- Drip irrigation and other methods of micro irrigation
- Crop selection should be based on efficiency of the crops to utilize water
- Reducing evapotranspiration by using water tight mulches on the soil
- Recycling of water
- Rainwater harvesting
- Traditional water conservation methods like – Zabo, Juhad etc
- Watershed management
- Resuse of wastewater
- Water treatment for domestic use by – flocculation, sedimentation, filtration and disinfection

Drought situation and solutions: Droughts are outcome of variability of climate. Though drought causes little structural damage and has slow onset, it is considered as natural hazard. Drought in India is related to both scarcity of rainfall and water resource management. Drought is not only confined to regions with deficient rainfall, it is also prevalent in regions of high rainfall. Himalayan regions are also prone to conditions of water scarcity. Worst drought in India was experienced in 2002. Probability of drought in India varies from region to region. Western Rajasthan experiences drought once in 2 years and Once in 15 years in Assam.

Solutions:

- Periodical review of water shortage
- Individual state specific drought proofing measures to be devised
- Crop diversification, farm ponds construction, adoption of microirrigation
- Promotion of water storage, conservation and rejuvenation
- Incentivise solar pumps for irrigation
- Harvesting rain water, recharging ground water, desiltation of irrigation tanks

- Check dams maintenance, prevention of leakage and pilferation of water from distribution network
- Reviving traditional and historical step wells
- Availing crop advisories to farmer through mobile app in their language
- Locating ground water resources using satellite technology and remote sensing
- Compulsory rain water harvesting in urban areas
- Promotion of alternate livelihood like dairy, poultry, beekeeping. Timber farming and floriculture
- Crop Insurance against drought

V. What is the role of remote sensing in the development of natural resources in India?

Ans: Remote sensing and GIS are promising tools for handling spatial and temporal data and help in integrating them for successful planning of natural resources. Remote sensing is the science of measuring the Earth using sensors mounted on high-flying aircrafts or satellites. These sensors collect data in the form of images and provide insights for manipulating analyzing, and visualizing those images.

n a natural resource-rich country like India, management, especially of land and water, is crucial for sustainable development. Management of natural resources calls for scientific tools for timely and accurate dissemination of information. Since natural resources are not uniformly distributed and are spatially varied, it is challenging to capture the correct picture.

Major applications:

- **Land management**: In India, the agriculture sector alone sustains the livelihood of around 50 per cent of the population (Ministry of Agriculture and Farmer's Welfare, 2016), therefore, increase in crop productivity has been the main concern. Since, the scope for increasing area under agriculture is rather limited, advanced crop production forecasting is required for better policy making. Even though globally there have been large experiments related to agriculture assessment, in India it was first attempted by the Indian Space Research Organization (ISRO) and the Indian Council of Agricultural Research (ICAR). The experiment–Agricultural Resource Inventory and Survey Experiment (ARISE) used

aerial colour photographs to estimate crop acreage in Anantapur district of Andhra Pradesh and in Patiala district of Punjab. The other major uses of remote sensing and GIS in agriculture include crop identification, stress detection, identification of planting and harvest dates, crop yield modeling, estimation of pest and disease infestation, soil moisture estimation, irrigation monitoring, soil mapping, drought monitoring, land covering, land degradation mapping and more.

- **Soil management:** GIS is a powerful tool that is especially relevant for soil management–information which could help prioritise development actions. GIS, RS and GPS have much to offer for preparing soil fertility maps. It is widely recognized that satellite remote sensing can provide an inexpensive, rapid and effective method of data collection and production of various kinds of thematic maps. Once the soil fertility maps are created, it is possible to transform the information from Soil Test Crop Response (STCR) models into spatial fertilizer recommendation maps. Such maps provide site-specific recommendation without testing the soil. The recommendations can be obtained by an extension agent/farmer simply by locating his farm on the map. Remote sensing has evolved into an important (supplement to ground observations in the study; of terrestrial vegetation and soil.
- **Watershed management:** A watershed is a natural hydrological unit and its management v involves the holistic linking of upstream and downstream areas. Scientists now recognize that the best way to protect natural resources is to understand and manage them on a watershed basis. Everything that is done in a watershed affects the watershed's system (Yongsheng, 2004). Watershed management provides a way for sustainability, integrating natural resource management with communities and their livelihood. They are important as ecological units from the perspective of conservation of rainfed marginal areas enabling a sustainable living. Availability of clean water is currently being regarded as a great challenge, especially in India. With the help of satellite data and GIS: water bodies such as rivers, lakes, dams and reservoirs can be mapped in 3D formats and the data can be used in the planning of sustainable management of water bodies. Watersheds are hydrologic units that are often used as biophysical and socio-economic or political units for the planning and management of natural resources.
- **Urban land management:** Urbanisation is important and inevitable for development, but its proper planning and management is crucial to sustenance. One of the features of GIS is multilayered mapping, which is significant for urban planning. Urban management requires layered data on a single map wherein use

of remote sensing and GIS applications comes handy. This data helps municipal corporations/ town planning boards to build cities that are better organized

- **Forest and ecosystem:** Forest cover of the world is declining at an alarming rate, but since it is a renewable resource, it can be regenerated through sustainable management. Remote sensing and GIS data can generate information with regard to forest cover and types of forest present within an area. This information is critical in the development of forest management plans and in the process of decision making to ensure that effective polices have been put in place to control and govern the manner in which forest resources are to be utilized. One of the important missions in this regard was the first national level remote sensing based mapping of the forest cover undertaken in 1983 following which the Forest Survey of India continues to publish bi-annual updates and reports.
- **Coastal zone management:** Coastal ecosystems have high ecological significance. GIS and remote sensing data is used to study coastal ecosystem and marine living resources which include coastal habitats like mangroves, coral reefs and more. Apart from this, suspended shoreline dynamics can be studied and climatic changes leading to cyclone and sea level rise may be of special interest too.
- **Geology/mineral resource management:** Remote sensing in mineral exploration can help miners find and evaluate deposits without having to undertake massive exploration operations. Such images are used in two key operations. Such images are used in two key ways–through mapping the geology, faults and fractures of an ore deposit and by recognizing hydrothermally altered rocks by their spectral signature.

Question No 3 (5 marks)

I. What is Astrosat? Describe its features and objectives.

Ans: AstroSat is the first dedicated Indian astronomy mission aimed at studying celestial sources in X-ray, optical and UV spectral bands simultaneously. The payloads cover the energy bands of Ultraviolet (Near and Far), limited optical and X-ray regime (0.3 keV to 100keV). One of the unique features of AstroSat mission is that it enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite.

AstroSat with a lift-off mass of 1515 kg was launched on September 28, 2015 into a 650 km orbit inclined at an angle of 6 deg to the equator by PSLV-C30 from Satish Dhawan Space Centre, Sriharikota. The minimum useful life of the AstroSat mission is expected to be 5 years.

Objectives:

- To understand high energy processes in binary star systems containing neutron stars and black holes;
- Estimate magnetic fields of neutron stars;
- Study star birth regions and high energy processes in star systems lying beyond our galaxy;
- Detect new briefly bright X-ray sources in the sky;
- Perform a limited deep field survey of the Universe in the Ultraviolet region.

At present, all the payloads are operational and are observing the cosmic sources. The spacecraft and payloads are healthy.

II. Write a note on Aditya L1.

Ans: The Aditya-1 mission was conceived as a 400kg class satellite carrying one payload, the Visible Emission Line Coronagraph (VELC) and was planned to launch in a 800 km low earth orbit. A Satellite placed in the halo orbit around the Lagrangian point 1 (L1) of the Sun-Earth system has the major advantage of continuously viewing the Sun without any occultation/ eclipses. Therefore, the Aditya-1 mission has now been revised to "Aditya-L1 mission" and will be inserted in a halo orbit around the L1, which is 1.5 million km from the Earth. The satellite carries additional six payloads with enhanced science scope and objectives.

Aditya-L1 with additional experiments can now provide observations of Sun's Photosphere (soft and hard X-ray), Chromosphere (UV) and corona (Visible and NIR). In addition, particle payloads will study the particle flux emanating from the Sun and reaching the L1 orbit, and the magnetometer payload will measure the variation in magnetic field strength at the halo orbit around L1. These payloads have to be placed outside the interference from the Earth's magnetic field and could not have been useful in the low earth orbit.

III. Write a note on India-based Neutrino Observatory Project and its significance for India.

Ans: Approval has been granted by the Union cabinet for setting up of a Neutrino Observatory for studying fundamental particles called the neutrinos. The location of the Observatory would be in the Bodi West Hills region of Theni district, about 110 kilometres west of Madurai in Tamil Nadu.

- INO involves the construction of an underground laboratory. The project location was initially decided to be located in the Nilgiris but later, on grounds that it was too close to tiger habitat, was moved to a cavern under a rocky mountain in the Bodi West Hills.
- It involves Inter-Institutional Centre for High Energy Physics (IICHEP) and Iron Calorimeter Detector (ICAL).
- Approval has also been granted to construct a magnetized Iron Calorimeter in order to study the properties of the neutrino, specifically, the mass hierarchy in various types of neutrino. It will be the largest in the world weighing over 50,000 tonnes.
- Department of Science and Technology and the Department of Atomic Energy jointly support the project.

Significance for India:

- It will be the largest experimental facility to come up in the country. It will facilitate the development of cutting-edge technology and build sophisticated instruments.
- Neutrinos may have a role to play in nuclear non-proliferation through the remote monitoring of nuclear reactors.
- Understanding neutrinos could help in detection of oil and mineral deposits.
- They may open up a faster way to send data than the current 'around the earth' model, using towers, cables or satellites as they can pass through the Earth.
- Neutrinos are the information bearers of the universe — which are almost never lost in their path. Efforts in studying neutrinos at INO may help unravel the deepest mystery of the universe

IV. What do you understand by Big Data? What are the applications of Big Data?

Ans: Big data is a term that describes the large volume of data – both structured and unstructured beyond the ability of commonly used software tools to capture, curate,

manage, and process data within a tolerable elapsed time. It's what organizations do with the data that matters. Big data can be analyzed for insights that lead to better decisions and strategic business moves.

Applications:

- Companies use big data to better understand and target customers by bringing together data from their own transactions as well as social media data and even weather predictions.
- Businesses optimize their processes by tracking and analyzing their supply chain delivery routes and combine that data with live traffic updates.
- Big Data is used in healthcare to find new cures for cancer, to optimize treatment and even predict diseases before any physical symptoms appear.
- Police forces and security agencies use big data to prevent cyber-attacks, detect credit card fraud, foil terrorism and even predict criminal activity.
- Big Data is used to improve our homes, cities and countries by optimizing the heating or lighting in our homes, the traffic flow in our cities, or the energy grid across the country.

V. What are biofuels? Briefly describe fourth generation biofuels.

Ans: A biofuel is any hydrocarbon fuel that is produced from organic matter in a short period of time. This is in contrasts with fossil fuels, which take millions of years to form and with other types of fuel which are not based on hydrocarbons like nuclear fuels. The structure of the biofuel itself does not change between generations, but rather the source from which the fuel is derived changes.

Bio fuels form an essential element of energy security of India. Being an environment friendly fuel it also addresses the climate change imperatives. India has a dedicated **National Bio Fuel policy** that acts as an overarching framework for bio fuels in India. Our Bio fuel production is based mostly on Jatropa.

Fourth generation biofuels: Fourth generation biofuels are simply a step further from the third generation biofuels. The keywords are "carbon capture and storage", both at the level of the feedstock and/or the processing technology. The feedstock is tailored not only to improve the processing efficiency, but it is also designed to capture more carbon dioxide, as the crop grows in cultivation. The processing methods (mainly thermochemical) are also coupled to "carbon capture and storage" technologies which funnels off the carbon dioxide generated into geological formations (geological storage,

for example, in exhausted oil fields) or through mineral storage (as carbonates). In this way, fourth generation biofuels are thought to contribute better to reducing GHG (greenhouse gas) emissions, by being more carbon neutral or even carbon negative compared to the other generation biofuels. Fourth generation biofuels epitomize the concept of "Bionergy with Carbon Storage (BECS)

VI. Is river linking project a solution to the water crisis problem in India? Examine.

Ans: **The interlinking of river** project is a Civil Engineering project, which aims to connect Indian rivers through reservoirs and canals. The farmers will not have to depend on the monsoon for cultivation and also the excess or lack of water can be overcome during flood or drought. This project will connect 60 rivers of India, including river Ganga. Hopefully with the help of this project, there will be a reduction in the dependence of farmers on uncertain monsoon rains and there will also be millions of cultivated land for irrigation.

Advantages/how it can solve water crisis in India:

- This project can solve the problem of drought and flood, because at the time of need the river which causes flood can give water to the area of river which have a shortage of water because the water can be stored or water can be transferred from water surplus area to the deficit. Ganga and the Brahmaputra region can get rid of floods that come every year with the help of this project.
- The irrigation, land will also increase by about 15 percent.
- 15,000 km of river and 10,000 km of navigation will be developed. Thereby reducing the transportation cost.
- Large scale afforestation and about 3,000 tourist spots will be built.
- This project will solve the problems of drinking water and financially also will solve the problem.
- It is also possible to get jobs for the landless farmers of rural areas.

Disadvantages:

- Rivers are being considered an integral part of our life from the beginning, and any kind of human intervention can prove to be destructive.
- For the completion of Interlinking River project, many big dams, canals and reservoirs will have to be constructed due to which the surrounding land will become swampy and will not be suitable for agriculture. This can also reduce the production of food grains.

- Taking the water of Ganga above the Vindhya towards Cauvery, will cost a lot more and for this, large diesel pumps will be used, more than 4.5 lakhs people will be almost displaced, 79,292 forests will also be submerged in water.
- Tiger reserves or other animal habitats may be affected adversely.

VII. What are the main causes of conflict over water? Name one on-going inter-state water conflict in India.

Ans: The main causes of conflict over water are:

- Irrigation needs of the states, especially the drier states like Maharashtra, Madhya Pradesh etc. These states continuously fight over how much water of the inter state rivers will be shared between them.
- Population increase also leads to more demand for drinking water, another cause of conflict.
- Greater industrialisation of the states increases the demand for water and thus causes conflict over water.
- India has many interstate rivers, thus more conflict over water sharing.
- Climate change has caused erratic changes in the water availability, thus increasing the conflict.

One on-going inter state water conflict is Cauvery water dispute.

- Cauvery is an inter-State basin having its origin Karnataka and flowing through Tamil Nadu and Puducherry before out falling in the Bay of Bengal. The states concerned are Kerala, Karnataka, Tamil Nadu and Puducherry (UT).

- **The Cauvery Water Disputes Tribunal** passed an Interim order in 1991 directing the State of Karnataka to release Water from its reservoirs in Karnataka so as to ensure 205 Thousand Million Cubic Feet (TMC) of water into Mettur reservoir of Tamil Nadu in a water year (1st June to 31st May) with monthly and weekly stipulations. Karnataka government refused to obey the interim award.
- After 16 years of hearing and an interim order, the Tribunal announced its final order in 2007 allocating 419 tmcft water to Tamil Nadu and 270 tmcft to Karnataka. Kerala was given 30 tmcft and Puducherry got 7 tmc ft. Both Karnataka and Tamil Nadu filed review petitions in Supreme Court.
- Karnataka has not accepted the order and refused to release the water to Tamil Nadu. In 2013, Contempt of Court was issued against Karnataka.
- In 2016, a petition was filed in Supreme Court to seeking the release of water by Karnataka as per the guidelines of the tribunal. When Supreme Court ordered Karnataka to release water, Kannada people protested the decision saying they do not have enough water.

- The matter is still sub judice (under judicial consideration).

VIII. What is disaster management? How can it be helpful in preventing the loss of lives and property in the event of occurrence of any disaster?

Ans: Disaster management Act, 2005 defines Disaster Management as an integrated process of planning, organizing, coordinating and implementing measures which are necessary for-

- Prevention of threat of any disaster
- Reduction of risk of any disaster or its consequences
- Readiness to deal with any disaster
- Promptness in dealing with a disaster
- Assessing the severity of effects of any disaster
- Rescue and relief
- Rehabilitation and Reconstruction

It is helpful in preventing loss of lives by:

- Evacuation, rescue and relief
- Timely response to any threatening situation
- Vigilance to deal with any disaster
- Capacity building as well as research and knowledge management
- Assessing the severity of the disaster to mitigate further damage
- Rehabilitation and reconstruction.

Question No 4 (2 marks)

I. **Brahmaputra Biodiversity and Biology Boat (B4)**
Ans: the government is planning to safeguard the fast eroding Majuli island and thus will carry out research on the floating Brahmaputra biodiversity and biology boat labs along the Brahmaputra river. The project will study the changes caused by dams, climate change, human interventions and eventual effects on the river eco system.

II. **GSLV MK III**: GSLV Mk III is a three-stage heavy lift launch vehicle developed by ISRO. The vehicle has two solid strap-ons, a core liquid booster and a cryogenic upper stage. GSLV Mk III is designed to carry 4 ton class of satellites into Geosynchronous Transfer

Orbit (GTO) or about 10 tons to Low Earth Orbit (LEO), which is about twice the capability of GSLV Mk II.

III. **Blue moon**: When there are two full moons within a month, the second full moon is called a Blue Moon.

IV. **Cloud computing**: it means delivering hosted services over the internet. It is the pool of shared resources such as networks, servers, storage, applications and services that can be provided to the consumer rather than the consumer managing them on her own which is costly and time consuming.

V. **LIGO and its uses**: LIGO is a large-scale physics experiment and observatory to detect gravitational waves. Its purpose is to detect cosmic gravitational waves and to develop gravitational-wave observations as an astronomical tool.

VI. What is the difference between sun synchronous and geostationary orbit?

Ans: A Sun-synchronous orbit is a nearly polar orbit around a planet, in which the satellite passes over any given point of the planet's surface at the same local mean solar time.

A geostationary orbit, is a circular geosynchronous orbit 35,786 km above Earth's equator and following the direction of Earth's rotation. An object in such an orbit appears motionless, at a fixed position in the sky, to ground observers. Communications satellites and weather satellites are often placed in geostationary orbits, so that the satellite antennae that communicate with them do not have to rotate to track them, but can be pointed permanently at the position in the sky where the satellites are located.

VII. **Bio ink**: Bioinks are substances made of living cells that can be used for 3D printing of complex tissue models. Bioinks are materials that mimic an extracellular matrix environment to support the adhesion, proliferation, and differentiation of living cells.

VIII. **Goldilocks Zone**: It refers to a habitable zone in the planetary system where the temperature is neither too high nor too low and probability of finding an earth like planet is higher. Such conditions could allow for the presence on the planet’s surface of liquid water – a key ingredient for life.

IX. **Pratyush and Mihir**: supercomputers developed by India

X. **5G**: is a fifth generation wireless communication technology that has very high reliability spectrum bands and speed which is around 10 plus Gbps (20 times that of 4G).

XI. DNA fingerprinting and its uses

Ans: **DNA** fingerprinting is the technique of finding the difference between the satellite DNA regions in the genome. Any piece of DNA sample found at a crime scene can be analysed for the level of polymorphism in the non-coding repetitive sequences. After the DNA profile is traced, it becomes easier to find the criminal by performing the DNA fingerprinting for the suspects. Apart from crime scenes, Fingerprinting applications also prove useful in finding the parents of an unclaimed baby by conducting Paternity test on a DNA sample from the baby.

XII. **Digital therapeutics**: Digital therapeutics, a subset of digital health, is a health discipline and treatment option that utilizes a digital and often online health technologies to treat a medical or psychological condition. The treatment relies on behavioral and lifestyle changes usually spurred by a collection of digital impetuses.

XIII. **Free space optical communication technology**: it is a line of sight optical communication technology in which data is transmitted by propagation of light in free space allowing optical connectivity. It is useful where the physical connections are impractical due to high costs or other considerations.

XIV. **KALAMSAT**: Kalamsat is a payload developed by students and Chennai based Space Kidz India for the first time. The Microsat-R satellite is meant for the Defence Research and Development Organisation (DRDO) purposes.

XV. What is social forestry

Ans: Social Forestry means the management and protection of forests as well as afforestation of barren lands with purpose of helping in the environmental, Social and rural development. Social forestry is forestry for community development. Thus, it is people oriented, value based management of forests with a major objective of satisfying the needs, wants and aspirations of both the people and the government.

XVI. What is meant by Water Divide?

Ans: Water divide is any elevated area such as a mountain or upland which separates two drainage basins. The Western Ghats act as water divide. It separate east flowing rivers such as Godavari, Krishna, Mahanadi, Cauvery, Vaigai, Pennar which finds its way to Bay of Bengal from the west flowing rivers such as Periyar, Bharathappuzha, Pamba, Netravati, Sharavathi, Mandovi and Zuari which drains into the Arabian sea.

XVII. **Name 4 rabi crops**: Barley, wheat, mustard, sesame

XVIII. Mention two geographic requirements for the growth of cotton in India.

Ans: it needs uniformly high temperature varying between 21-30 degrees Celsius. It needs modest amount of water which can be met by average annual rainfall of 50-100cm.

XIX. **Name the two countries having international boundary with the states of North-East India:** Bangladesh, Myanmar

XX. How has climate change affected the production of tea in Assam?

Ans: Incessant and intense rains cause the erosion and waterlogging of soil which affects tea production.

XXI. **Clean Ganga Mission**: It is a river cleaning project, to bring all the stakeholders on one platform to take a holistic approach towards the task of Ganga cleaning and rejuvenation. It was established in 2011.

XXII. **LED Bulb**: It is a solid state lighting device that fits in standard screw-in connections but uses LEDs to produce light. They are more environmentally friendly compared to the incandescent bulbs.

XXIII. **Name of Brahmaputra in its upper course and lower course**: Tsangpo and Jamuna

XXIV. **Seismograph and its application**: It is a device that detects and records earthquakes.

XXV. **Horse latitude**: The horse latitudes are subtropical regions known for calm winds and little precipitation. The horse latitudes are regions located at about 30 degrees north and south of the equator.

XXVI. **Black soil zone of India**: Black cotton soil is found generally in central India. Mostly a very big part of India known by its famous name as Deccan Plateau has majority of black soil (black cotton soil) in India. This portion consists of mainly Maharashtra and Karnataka including some parts of Gujrat and Madhya Pradesh.

XXVII. **Which is the largest fresh water lake in India? Where is it located?** Wular Lake, Jammu & Kashmir

XXVIII. **Organic farming**: Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, genetically modified organisms and livestock food additives. To the maximum extent possible organic farming system rely upon crop rotations, use of crop residues, animal manures, legumes, green manures, off farm organic wastes, biofertilizers, mechanical cultivation, mineral bearing rocks and aspects of biological control to maintain soil productivity and tilth to supply plant nutrients and to control insect, weeds and other pests.

XXIX. **Two renewable energy sources of India**: solar energy, wind energy

XXX. **Biodiesel and its uses**: Biodiesel is an alternative fuel similar to conventional or 'fossil' diesel. Biodiesel can be produced from straight vegetable oil, animal oil/fats, tallow and waste cooking oil. The process used to convert these oils to Biodiesel is called transesterification. It can be used instead of conventional diesel, to reduce pollution.