Model Answer Paper

AS-2305

M. Sc. (Ist Semester) Examination, 2013

FORESTRY

Paper: III

(Forest Management, Remote Sensing and GIS)

Q.1. (a) Fill in the Blanks:

Answer: **6 x 2 = 12**

i. A felling area usually one of an annual series is called **Coupe**

ii. The part or parts of forest set aside to be regenerated or otherwise treated during a specified period is known as **Periodic block.**

iii. **Stocking** refers to the adequacy of a given forest stand density to meet some specified management objectives.

iv. **Financial rotation** is the rotation which yields the highest net return on the invested capital.

v. Yield regulation by increment method is mathematically expressed as **Y= V+ a – Vn / n.**

vi. Visible range of EMR ranges between **0.4 - 0.7 micron meter.**

(b) Describe the following in brief:

Answer:

(i) Map Scale:

Length on a map or globe and its relation to the same distance on the earth expressed as a ratio.

Or,

Way of reducing actual distance on the earth's surface so that it fits on a map.

There are three types of Scales:

1. **Graphical Scale:**

   i.e.: 1cm to 1km/1cm represents 1km. This means that 1cm on the map represents 1km on the earth's surface.

2. **Fractional Scale:** written in numbers as a ratio i.e: 1:100 000 or 1/100 000. This means that 1cm on the map represents 1km on the earth's surface.

3**. Verbal Scale:** Use a ruler to measure linear scale i.e 1cm represents 1km on the earth's surface.

(ii) Criteria and Indicators:

Answer: Criteria and indicators are tools used to define, assess and monitor periodic progress towards sustainable forest management in a given country or in a specified forest area, over a period of time.

The ultimate aim of criteria and indicators is to promote improved forest management practices over time, and to further the development of a healthier and more productive forest estate, taking into consideration the social, economic, environmental, cultural and spiritual needs of the full range of stakeholder groups in countries concerned.

Criteria: define the essential elements against which sustainability is assessed, with due consideration paid to the productive, protective and social roles of forests and forest ecosystems. Each criterion relates to a key element of sustainability, and may be described by one or more indicators.

Indicators: are parameters which can be measured and correspond to a particular criterion. They measure and help monitor the status and changes of forests in quantitative, qualitative and descriptive terms that reflect forest values as seen by those who defined each criterion.

Criteria and indicators are applied at three different levels:

1. Regional
2. National
3. Forest management unit level

The guiding framework for evolving National level C & I under the Bhopal-India Process by the Indian Institute of Forest Management, Bhopal was borrowed from the ITTO. The Bhopal-India Process has recommended 8 Criteria and 43 Indicators. Criteria and indicators have been also adopted to promote sustainable forest management and facilitate the evaluation of progress towards it. The six Pan-European criteria for SFM are:

- Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles;
- Maintenance of forest ecosystems' health and vitality;
- Maintenance and encouragement of productive functions of forests (wood and non-wood);

- Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems;
- Maintenance, conservation and appropriate enhancement of protective functions in forest management (notably soil and water); and
- Maintenance of other socio-economic functions and conditions.

(iii). Periodic Blocks:

Answer: A Periodic block is defined as the part or parts of forest set aside to be regenerated, or otherwise treated, or otherwise treated during a specified period. The regeneration block is called floating or single when it is the only P.B. allotted at each working plan revision; they are termed fixed or permanent.

The number of periodic blocks in the working cycle or felling series is found by dividing the rotation by the regeneration period for example Chir pine forests worked under uniform shelter wood system on a rotation of 120 years and regeneration period of 30 years will be 120/30 = 4 and the normal area f each P.B. is the area of the W.C. or F.S. divided by the number of P.B.s.

The P.B.s 1-30 year age –class and at the end of the 120 years age class and at the end of a 120 year rotation, they whole working cycle would have similarly been converted into four P.B. s containing age classes 91-120, 61-90, 31-60, and 1-30 and designated as P. B. I, P.B. II, P.B. III and P.B. IV respectively.

(IV) IIRS:

Answer: The Indian Institute of Remote Sensing is the training and education arm of the Indian Department of Space. Located in Dehradun, the institute offers courses in Remote sensing and Geographic Information Systems (GIS), ranging in length from one week to two years.

This Institute has come a long way. Journey from photo-interpretation to institute for remote sensing and Geographical science and IIRS has come to qualify for international stature. Today we have courses for all levels of users from researchers to policy makers. Its goal is to develop a mechanism from pixel to policy through human capacity building in Natural Resource Management. It is focusing to develop electronic course through Internet/developing network with non remote sensing institutions and nation building programme and increasing its outreach. Besides, IIRS has also contributed towards several R & D projects that has helped in operationalisation of technology in various application areas like landslide hazard zonation, ground water targeting etc.

Indian Institute of Remote Sensing, Dehradun has been premier institute responsible for capacity building in the field of Remote Sensing and GIS applications. It has grown manifolds and establish itself as an institute of repute both nationally and internationally.

Q.2. Describe the principle, scope and objectives of scientific, technical and economical aspects applied to forestry.

Answer: The forests make up one of the earth's greatest reservoirs of renewable resources. Properly managed, they can provide essential products indefinitely and at the same time remain a home for wildlife and a vital source of water supplies. Forest management is the process of organizing forest stands/ecosystems so that they produce a continuous stream of whatever resources are desired from that forest-timber, wildlife tourism, recreation, or any conceivable combination of the resources of the forest. The forester's task then, is to facilitate the production of resources from the forest in a manner that ensures that they will be forever available. The management techniques for accomplishing these purposes vary from the extraordinary simple to the exceedingly complex.

Forest Management:

Definitions:

(1) Forest Management is the practical application of the scientific, technical and economic principles of forest.

(2) It is that branch of forestry whose function is the organization of a forest property for management and maintenance, by ordering intime and place the various operations necessary for the conservation, protection and improvement of the forest on the one hand, and the controlled harvesting of the forest on the other hand.

(3) It is the application of business methods and technical forestry principles to the operation of a forest property.

(4) The task of forest management is to build up, put in order, and keep in order a forest business.

(5) The practical application of scientific, economic and social principles to the administration and working of a forest estate for specified objectives.

(6) It is that branch of forestry concerned in broad sense with the overall administrative, economic, legal and social aspects and in strict sense with technical and scientific aspects, especially silviculture, protection and forest regulation. Forest regulation concerns with the

technical aspects of organizing and maintaining a forest to fulfill the objects of forest management.

Thus, forest management is the practical application of science, technology and economics to a forest estate for the achievement of certain objectives like production of wood, timber and industrial raw material, and other forest products. In its restricted sense, it is more especially concerned with the organization of a forest for the purpose of securing a sustained yield from it and for realizing the objects of management.

Principles of Forest Management:

The forest policies of many countries carry the following sentence:

1. "To manage the forest in such a way as to ensure a sustained yield of timber and other forest products in perpetuity."
2. The most celebrated principle of forest management all over the world is the "Principle of Sustained Yield". This being criticized as static one, was replaced by the "Principle of increasing yield" in the recent past. But this new concept covers only those forests which are in the early stages of their development.
3. Yet another concept known as "Principle of Progressive Yield" emerged in Helsinki World Forestry Congress in 1948, but this is applicable to fast growing, short rotation species responding readily to the scientific methods. Thus for long term forest the "Principle of Sustained Yield" remains unchallenged.

Scope of Forest Management:

Though forest management is an integration of silviculture, silvicultural systems, protection, economics etc., each of which is a separate subject itself; "Yield Regulation" remains the core subject of forest management. It involves the study of sustained yield, normal forest, management units, rotation, increment, yield calculation, and serves as a tool in answering to the questions when to cut, how much to cut, and what to cut, i.e. for establishing sustained yield forest management plans.

Management of forests broadly involves:

- Control of composition and structure of the growing stock.
- Harvesting and marketing of forest produce.
- Administration of forest property and personnel.

Objectives of Forest Management:

The objectives of forest management are embodied in National Forest Policy of the country. The National Goals provide the basis for forest policy.

(1) To ensure the sustainability of forests, i.e. through proper management practices, the forests may be used and are retained as renewable resource; and

(2) Forests are harvested in order to bring about economic growth, job creation, increased participation. Careful uses without changing the character of the forest, and successful regeneration after harvest ensure the sustainability of forests.

Q.3. Define remote sensing and its role in forest resource management?

Answer: Remote sensing can be broadly defined as the collection and interpretation of information about an object, area, or event without being in physical contact with the object. Aircraft and satellites are the common platforms for remote sensing of the earth and its natural resources.

According to the United Nations, Remote Sensing means sensing of earth's surface from space by making use of the properties of electromagnetic wave emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resource management, land use and the protection of the environment.

Principals of remote sensing:

1. Source of electromagnetic radiation or EMR, (Sun): Electromagnetic energy refers to all energy that moves with the velocity of light in a harmonic wave pattern. The electromagnetic spectrum is the continuous range of electromagnetic radiation, extending from gamma rays (highest frequency & shortest wavelength) to radio waves (lowest frequency & longest wavelength) and including visible light. Remote sensing involves the measurement of energy in many parts of the electromagnetic spectrum. The major regions of interest in satellite sensing are visible light, reflected and emitted infrared, and the microwave regions. The measurement of this radiation takes place in what are known as spectral bands.

A passive Remote Sensing system records the energy naturally radiated or reflected from an object. An active Remote Sensing system supplies its own source of energy, which is directed at the object in order to measure the returned energy.

2. Transmission of energy from the source to the surface of the earth, through atmosphere:

Our eyes inform us that the atmosphere is essentially transparent to light, and we tend to assume that this condition exists for all Electromagnetic radiation. In fact, however, the gases of the atmosphere selectively scatter light of different wavelengths. Particles and gases in the atmosphere can affect the incoming light and radiation. These effects are caused by the mechanisms of scattering and absorption.

Scattering:

Scattering occurs when particles or large gas molecules present in the atmosphere interact with and cause the electromagnetic radiation to be redirected from its original path. How much scattering takes place depends on several factors including the wavelength of the radiation, the abundance of particles or gases, and the distance the radiation travels through the atmosphere. There are three (3) types of scattering which take place.

Rayleigh scattering occurs when particles are very small compared to the wavelength of the radiation. These could be particles such as small specks of dust or nitrogen and oxygen molecules. Rayleigh scattering causes shorter wavelengths of energy to be scattered much more than longer wavelengths.

Mie scattering occurs when the particles are just about the same size as the wavelength of the radiation. Dust, pollen, smoke and water vapour are common causes of Mie scattering which tends to affect longer wavelengths than those affected by Rayleigh scattering.

3. Interaction of EMR with earth's surface A number of interactions are possible when Electromagnetic energy encounters matter, whether solid, liquid or gas. The interactions that take place at the surface of a substance are called surface phenomena.

· Radiation may be reflected. If it is returned unchanged from the surface of a substance with the angle equal and opposite to the angle of incidence, it is termed specular reflectance. If radiation is reflected equally in all directions, it is termed diffuse. Real materials lie somewhere in between.

4. **Transmission of Energy from Surface to Remote Sensor Mounted on the Platform*:***

While EMR is transmitted from the surface of the earth to the sensor, it again passes through the atmosphere. Here, electromagnetic radiation is modified again in the same way as it is transmitted from the sun to the surface of the earth.

In order for a sensor to collect and record energy reflected or emitted from a target or surface, it must reside on a stable platform removed from the target or surface being observed. Platforms

for remote sensors may be situated on the ground, on an aircraft or balloon (or some other platform within the Earth's atmosphere), or on a spacecraft or satellite outside of the Earth's atmosphere.

***5.* Data Interpretation:**

In the foregoing paragraphs, we have studied two major types of Remote Sensing data products, viz. pictorial and digital. The pictorial data products, such as aerial photographs and satellite imageries are interpreted visually. Likewise, digital data products or digital images are interpreted mathematically by using computer software. So, there are two ways of Remote Sensing data interpretation – 1) Visual Interpretation and 2) Digital Interpretation.

Role if Remote Sensing in Forest Management:

The first step towards the sustainable forest management of any region or country is to have a clear status of the resource base. Remote sensing along with GIS and direct field measurements have shown the potential to facilitate the mapping, monitoring, and modeling of the forest resources. In addition to the inventory requirements the role of remote sensing extends to facilitate the operational forest management activities as well.

1. Vegetation/cover type mapping:

Remote sensing can provide information on forests through classification of spectral response pattern. The distribution of vegetation types and their spatial arrangements are of great interest to forest managers.

Forest cover, crown closure, and tree density:

It has been discussed widely in literature that the Landsat and SPOT data were related to forest cover, stand age, and crown closure. The darker image tones because of decreasing visible reflectance would be associated with the increasing crown development. The increasing stand size and age resulting in larger canopy were found to reflect more strongly in infrared because greater atmospheric penetration would create deeper shadows from larger tree.

Forest Age:

The remote sensing data will be suggestive of age or age classes based on the differences in tree size, density, understory, canopy developments, nutrient status, and species type among the young and old forest stands, which in turn will effect the illumination, absorption, and shadows in the image. <80 years, 80-200, and >200 years old by relating the changes in illumination, absorption, and shadows to the spectral response pattern.

Tree Height:

The use of aerial photography for tree height estimation is well known to forest managers as well as remote sensing scientists. The tree height estimation is usually used in the development of other information of interest in forest management such as to predict timber volume and so on. The digital airborne and satellite remote sensing are not very successful in producing reliable estimates of tree or canopy height and the biophysical relationship between the height and spectral response are rarely strong enough to justify the model development. However, there are successful attempts in site specific situations that relate photogrammetric principles to shadows on imagery and to estimate height as a relative attribute in few general height classes.

Biomass Estimation:

Traditionally the stand biomass estimates are derived by conversion of stem volume estimates from forest inventory database or through forest cover type volume tables in less well inventoried areas. The recent strategy has been to develop large scale system for biomass estimation by referencing all available information from the forest inventory, satellite and airborne imagery, and field data in a multistage approach.

2. Change Detection:

In addition to the cover type mapping and forest resources inventory, remote sensing has strong application in detecting and mapping the changes in the forest landscape that are dynamic in nature. There are slow changes such as due to successional, growth, structural, and age processes that are variable in nature over time and space.

3. Biodiversity assessment and habitat modeling:

Wildlife habitat mapping from satellite remote sensing data has been of interest for long mainly because of its potential to provide highly accurate and effective maps generated from synoptic, repetitive, and consistent reflectance data over large forest areas.

Q.4. Define Rotation. Explain in detail types of Rotation?

Answer: It is also known as Production period. It is the period which a forest crop takes between its formation and final felling. It is not common one to all forest crops, nor for the same crop in different regions. It expresses the rate of growth of the crop to produce the desired size and quality of crop.

Definitions:

- The planned number of years between the formation or regeneration of a crop and its final felling. In the case of a selection forest, the average age at which a tree is considered mature for felling.
- The period of years required to establish and grow timber crops to specified conditions of maturity.
- The number of years fixed by the working plan between the formation or regeneration and the final felling of a forest crop.
- The interval of time between the formation of a young crop by seeding, planting or other means and its final harvesting.
- The period which elapses between the formation of a wood and the time when it is finally cut over.

Types of Rotation:

Based on the objects of management and also of "necessity", the rotation is classified as: Physical rotation, Silvicultural rotation, Technical rotation, Rotation of maximum volume production, Rotation of highest income, Financial rotation/Economic rotation.

i. **Physical Rotation:** Rotation that coincides with the natural lease of life of a species on a given site. Trees are harvested only on their death. This is followed in protected forests, park lands, roadside avenues, recreation forestry etc.. It is not relevant in economic forestry.

ii. **Silvicultural Rotation:** The rotation through which a species retains satisfactory vigour of growth and reproduction in a given site. This rotation presupposes the crops which are regenerated by natural means and coppicing. It is not only long but has also very wide range of limits. It is useful in forests managed primarily for aesthetic and recreational purposes, where large old trees with accompanying regeneration provide scenic beauty. Some foresters do not distinguish between Physical and Silvicultural rotations.

iii. **Technical Rotation**: Rotation under which a species yield the maximum material of a specified size or suitability for economic conversion or for special use. The harvest depends upon the form in which he market demands the forest product to suit specific purposes, e.g. transmission poles, railway sleepers, match wood, paper pulpwood, saw

logs etc. It is adopted, particularly, by industrial firms which own forests and plantations for the purpose of supplying raw materials for their plants.

iv. **Rotation of Maximum Volume Production:** The rotation that yield the greatest annual quantity of material or that which produces the greatest mean annual increment of wood. This is the widely used rotation throughout the world. It embodies the principles of sustained yield. Besides it aims profitable extraction and sale of wood. Maximum volume production is achieved when the mean annual increment (MAI) of a crop reaches the culmination point. This rotation yields largest volume per unit area, per annum, and is an important rotation which is adopted frequently. It is suitable where the total quantity of woody material is important and not the size and specification, like firewood, raw material for paper pulp, fibre and particle board industries based on disintegration processes of wood.

v. **Rotation of Highest Income:** It is the rotation that yields highest average annual gross or net revenue irrespective of the capital value of the forests; also known as rotation of highest revenue or forest rental. It is calculated without interest and irrespective of the times when the items of income or expenditure occur. Land value is also not considered in this case. This rotation is fixed under the assumption that the wood has same value whatever its size, and annual expenses do not vary with alterations in the rotation

vi. **Financial Rotation:** Financial Rotation: It is the rotation which yields the highest net return on the invested capital. It is a rotation determined on financial considerations, i.e., that yielding the highest rate of interest. It is also known as "Economic Rotation". In this rotation all items of revenue and expenditure are calculated with compound interest at an assumed rate, usually the rate at which the Government is able to borrow money.

Q. 5. What do you mean by increment? Differentiate between Current Annual Increment and Mean Annual Increment.

Answer: Forest is a capital in the economic sense, which should produce interest. Trees are the capital and growth (increment) is interest; both are indistinguishable. Increment is the increase in growth of a tree or crop with age. It may be in term of wood content, or any of the factors which increase with age-diameter, height, basal area, volume, quality price or value. It is determined for any given period, by measuring it at the beginning and at the end of the period.

Definition: The increase in girth, diameter, basal area, height, volume, quality, price of individual trees or crops during a given period.

In Forest Management, the term increment refers usually to only volume increment, and that too of crops rather than of individual trees. It is intimately connected with the volume and age of the crops.

Current Annual Increment (C.A.I.): The increase in growth that takes place in a particular year is called the C.A.I. for that year. Usually taken as the periodic annual increment over a short preceding period. It may be expressed as (V (n+1) – Vn) where V (n+1) is the volume of wood produced in (n+1) year and Vn the volume in n years.

Mean Annual Increment (M.A.I.): It is the average annual rate of growth up to any given date i.e., it is an average rate of growth representing the total growth or yield at a given age distributed or spread over the period. The total increment up to a given age divided by that age is M.A.I. The volume of a tree is built up of successive C.A.Is., which, of course, vary considerably from year to year. The C.A.I. is a chapter in the history of the tree. The mean of all C.A.Is. is known as Mean Annual Increment (M.A.I.) an average annual rate of growth upto any given age; it is derived by dividing total increment upto any specified age by that age.

M.A.I. = (Vx – Vo)/x, when Vx is volume at the end of x years; Vo is the volume at the beginning.

Final Mean Annual Increment (F.M.A.I.): It is the M.A.I. at rotation age. This is calculated by dividing the total of volumes (final yield at the end of rotation + intermediate yields from thinnings, etc.) by the rotation period.

F.M.A.I. = (Vr + Vi)/r, when Vr is the volume at the end of rotation;

Vi is the intermediate yield, and

r is the rotation in years.

Q. 6. Describe the history of forest Management in India. Discuss the importance and need of sustainable development of forests in Indian context? 10 X 1 =10

Answer: There is enough evidence to show that dense forests once covered India. The changing forest composition and cover can be closely linked to the growth and change of civilizations. Over the years, as man progressed the forest began gradually depleting. The growing population and man's dependence on the forest have been mainly responsible for this.

All ancient texts have some mention of the forest and the activities that were performed in these areas. Forests were revered by the people and a large number of religious ceremonies centred on trees and plants. The Agni Purana, written about 4000 years ago, stated that man should protect trees to have material gains and religious blessings. Around 2500 years ago, Gautama Buddha preached that man should plant a tree every five years. Sacred groves were marked around the temples where certain rules and regulations applied When Chandra Gupta Maurya came to power around 300 BC, he realized the importance of the forests and appointed a high officer to look after the forests. Ashoka stated that wild animals and forests should be preserved and protected. He launched programmes to plant trees on a large scale. These rules continued even during the Gupta period.

During the Muslim invasions a large number of people had to flee from the attacks and take refuge in the forests. This was the beginning of a phase of migration to the forest. They cleared vast areas of forests to make way for settlements.

The Muslim invaders were all keen hunters and therefore had to have patches of forests where they could go hunting. This ensured that the trees in these areas were not felled, and the forest ecology was not tampered with. The Mughals showed more interest in gardens and their development. Akbar ordered the planting of trees in various parts of his kingdom. Jahangir was well known for laying out beautiful gardens and planting trees.

During the early part of the British rule, trees were felled without any thought. Large numbers of trees such as the sal, teak, and sandalwood were cut for export. The history of modern Indian forestry was a process by which the British gradually appropriated forest resources for revenue generation. Trees could not be felled without prior permission and knowledge of the authority. This step was taken to ensure that they were the sole users of the forest trees.

But after some time, the British began to regulate and conserve. In 1800, a commissioner was appointed to look into the availability of teak in the Malabar forests. In 1806, the Madras government appointed Capt. Watson as the commissioner of forests for organizing the production of teak and other timber suitable for the building of ships.

In 1855, Lord Dalhousie framed regulations for conservation of forest in the entire country. Teak plantations were raised in the Malabar hills and acacia and eucalyptus in the Niligiri Hills.

In Bombay, the conservator of forest, Gibson, tried to introduce rules prohibiting shifting cultivation and plantation of teak forests. From 1865 to 1894, forest reserves were established to

secure material for imperial needs. From the 18th century, scientific forest management systems were employed to regenerate and harvest the forest to make it sustainable. Between 1926 and 1947 afforestation was carried out on a large scale in the Punjab and Uttar Pradesh. In the early 1930s, people began showing interest in the conservation of wild life.

During World War I forest resources were severely depleted as large quantities of timber were removed to build ships and railway sleepers and to pay for Britain's war efforts. Between the two wars, great advancements in scientific management of the forests were made, with many areas undergoing regeneration and sustained harvest plans being drawn up. Sadly, emphasis was still not on protection and regeneration but on gaining maximum revenue from the forests. World War II made even greater demand on the forest than World War I had done.

With the independence of India in 1947, a great upheaval in forestry organization occurred. The princely states were managed variably, giving more concessions to the local populations. The transfer of these states to the government led to deforestation in these areas. But some forest officials claim that the maharajas cut down a lot of their forests and sold them. This may have been the case in some instances, but a lot of forest had existed and has been lost since the government took over these states.

The new Forest Policy of 1952 recognized the protective functions of the forest and aimed at maintaining one-third of India's land area under forest. Certain activities were banned and grazing restricted. Much of the original British policy was kept in place, such as the classification of forest land into two types.

In pursuance of India's new forest policy of 1988, the central government issued broad guidelines for encouraging people's participation in forest management. By 2001, 25 of the 28 states came out with their own program of partnership and usufruct1 sharing mechanisms with people, popularly known as the JFM program. The Joint Forest Management (JFM) program is described as "a forest management strategy under which the government represented by the Forest Department and the village community enter into an agreement to jointly protect and manage forestlands adjoining villages and to share responsibilities and benefits" (Government of India, 2002). The 1988 National Forest Policy laid the foundation for the preponderance of conservation over commercial forestry and people's participation throughout the decades of exclusionary regime in India. The 1990 resolution of the Ministry of Environment and Forests on JFM was a blueprint for devolution, intended to guide participatory forest management in

different states of the country. In view of a shift in paradigm in natural re-source governance across international boundaries, the JFM program in India was a laudable effort towards devolution and decentralization in forest administration. An increasing focus on people-centered policies, bottom-up planning processes, and decentralized governance are some of the key characteristics of this new paradigm. Beginning in 1990, the JFM program in India is one of the biggest comanagement efforts of the world that acted as a policy vehicle for resolving forest resource conflicts. Recent data indicate that 99,000 registered JFM committees are involved in managing 214,300 square km of forests in 28 states of India involving 13.8 million families, 28.75 percent of which are tribal.

Forests in India are mostly state owned and cover an area of 67.71 million hectares, corresponding to 20.60 percent of the total geographical area of the country. Nearly 100 million people reside in forests and another 275 million live on the periphery and earn their livelihood from forests. The livelihoods of approximately 370 million people who directly or indirectly depend on forest products and services are therefore mired in poverty. There is a very huge pressure on the forest resources for meeting the needs and livelihoods of both human and animal population which is increasing at an alarming rate.

Q.7. What do you mean by Growing stock? How you will determine normal growing stock in clear felling system? 10X 1= 10

Answer: Growing stock is defined as the the sum by numbers or volume of all the trees growing in the forest or a specified part of it.

Normal growing stock is defined as the total volume of trees in a fully stocked forest with normal distribution of age classes for a given rotation.

Determination of actual growing stock:

It may be determined by any of the following methods:

1. By complete or total enumeration
2. By sample or partial enumeration
3. By sample plot measurement

Determination of normal growing stock: N.G.S. in clear felling system:

a). Based on final M.A I:

i. r x i = I.

ii. Final M.A.I of any age gradation multiplied by rotation, r.

iii. The sum of C.A. I s of all the r age gradations.

iv. The total M.A.I. of all the series.

b). Calculation of N.G. S. from yield table:

Volume of N.G.S. can be accurately determined by plotting the yield table on graph paper drawing a smooth curve either by planimeter, area square or by counting the squares.

Different formulas and equations used for determination by this method are:

A+ B x n+1/2, B+C x n+1/2, and C+D x n+1/2.

Summing up the N.G.S. volume will be;

n+1/2. x (A+ A+B+ B+C+C+D)-(A+ B+C)

= (n+1) (A+ B+ C+ D/2) – (A+B+C) = n(A+B+C+D/2) + D/2.

Q.8. Write short notes on the following: 4 X 2.5 = 10

Answer: (a) Coupe:

A felling area usually one of the annual series is called coupe.

The clear felling system is a silvicultural system in which equal or equiprodcutive areas of mature crop are successively clear-felled in one operation to be regenerated most frequently, artificially but sometimes naturally also. The new crop produced is absolutely even-aged. It requires large sums of money and large number of laborers to regenerate the forest artificially.

The area to be clear-felled each year in uniformly productive sites is l/n of the total area allotted to this system, where n = number of years in the rotation and is usually referred to annual coupe. The coupes to be felled every year are made equi-productive.

(b) Stand Density:

Stand density is a measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height of the tree of average basal area. It may also be defined as the degree of crowding within stocked areas, using various growing space ratios based on crown length or diameter, tree height or diameter, and spacing. Stand density index is usually well correlated with stand volume and growth, and several variable-density yield tables have been created using it. Basal area, however, is usually satisfactory as a measure of stand density index and because it is easier to calculate it is usually preferred over SDI.

Let's assume that a stand with basal area of 150 square feet (14 m^2) and 400 trees per acre is measured. The dbh of the tree of average basal area D is:

$$\sqrt{\frac{150}{400 \times .005454}} = 8.29$$

Substituting this value into the stand density equation gives:

$\log_{10}SDI = \log_{10}(400) + 1.605\log_{10}(8.29) - 1.605 = 2.47$

$SDI = 10^{2.47}$

SDI = 295

(c) Special objects of forest management:

The ultimate object of management is to convert the forests into normal forest and to bring about all round improvement to the forests so that they reach a state of maximum productivity in the shortest possible time. The immediate objects of management are:-

I. To work the forests scientifically on the principle of sustained yield by restricting the quantum of felling equal to the increment put on by the forests.

II. To manage the commercial or the surplus forests to ensure highest possible sustained financial return to the State.

III. To manage the community or the deficit forests in such a way as to meet the righholders demand for timber and firewood as far as practicable and to enrich these forests so as to improve the village economy.

IV. To rehabilitate the degraded forest.

V. To improve the density and quality of forests by planting the blanks and areas containing inferior & useless species.

(d) Kinds of abnormality in forest:

The deviation from the normal series of age gradation, normal increment and and normal growing stock of any forest is called the abnormality of that forests.

Forests may be abnormal usually in the following ways:

i. They may be overstocked.

ii. They may be understocked.

iii. Abnormal distribution of age classes or age gradation.

iv. The increment may be sub- normal.

v. Normal increment in an abnormal forest.