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Department of Forestry, Wildlife & Environmental Sciences
MODEL ANSWER AS-2303
M.Sc. Forestry (Semester I)
Paper-I (Silviculture)

Note: Attempt only five questions. Question number 1 is compulsory.

Q 1. A) Multiple choice questions. **(1x10)**

1. Chir forest is generally managed under regular shelterwood system, the seed bearer per hectare vary between-
   a. 5-10
   b. 10-15
   c. 50-60
   d. None of these
   ANS:- b. 10-15

2. The national forest policy, which recommended that no good agricultural land be diverted for forest plantation.
   a. 1894
   b. 1952
   c. 1988
   d. None of these
   ANS:- c. 1988

3. Exotic species
   a. *Eucalyptus grandis*
   b. *Populous deltoides*
   c. *Pinus kesiya*
   d. All of these
   ANS:- d. All of these

4. Is a growth regulator hormone-
   a. IAA
   b. BHC
   c. DDT
   d. None of these
   ANS:- a. IAA

5. Deciduous trees require pruning in –
   a. Active period
   b. Dormant period
   c. Both a&b
   d. None of these
   ANS:- b. Dormant period

6. The height of Dominated tree is-
   a. ¾ of the tallest trees
   b. 5/6 of the predominant
   c. ½ to 5/8 of the predominant
   d. None of these
   ANS:- a. ¾ of the tallest trees

7. Laurie's formula for irregular Sal crop under mechanical thinning is
   a. d=1.5 D
   b. d=D
   c. d=2D
   d. none of these
   ANS:- a d=1.5 D

8. Characterised by slow self pruning of the side branches.
   a. Light demander
   b. Shade bearer
   c. Resistant species
   d. All
   ANS:- b. Shade bearer

9. The greatest photosynthetic effect is produced in wave region-
   a. 0.012 to 0.40μ
   b. 0.66 to 0.68 μ
   c. 0.76 μ to less than 2 mms
   d. None of these
   ANS:- b. 0.66 to 0.68 μ

10. The canopy density is classified as open when density is-
    a. 1.0
    b. 0.50 to 0.75
    c. 0.5
    d. 0.75 to 1.0
    ANS:- c 0.5

Q1. B) Answer in one word /sentences **(1x5)**

1. Forest regenerated from seed
2. The optimum range of temperature for growth
3. Bamboo is popularly called
4. Perennial plant which is never entirely without green foliage
5. A strip of trees and/or shrubs planted in order to protect fields, homes, canals or other areas from wind.

Answers:-

1. **High forest**
2. **25 ^{o}C- 30^{o} C**
3. **Poor men's Timber**
4. **Evergreen**
5. **Wind Break**

Q1. C) State true of false **(1x5)**

1. Protected forest is under the provision of Chapter III of the Indian Forest Act 1927 **(False)**
2. India's forest policy was enunciated in 1894. **(True)**
3. The Steppes occupied by tall grass which adjoin forest are often called Prairies. **(True)**
4. *Cedrus deodara* is a strong coppice. **(False)**
5. German thinning is commonly called as crown thinning. **(False)**

Q2. Differentiate between weather and climate. What is the importance of light factor in Silvicultural practices?

Ans:-

	Weather	Climate
Definition:	Describes the atmospheric conditions at a specific place at a specific point in time. Weather generally refers to day-to-day temperature and precipitation activity	Describes the average conditions expected at a specific place at a given time. A region's climate is generated by the climate system, which has five components:atmosphere, hydrosphere, cryosphere, land surface, and biosphere.
Components:	Weather includes sunshine, rain, cloud cover, winds, hail, snow, sleet, freezing rain, flooding, blizzards, ice storms, thunderstorms, steady rains from a cold front or warm front, excessive heat, heat waves and more	Climate may include precipitation, temperature, humidity, sunshine, wind velocity, phenomena such as fog, frost, and hail storms over a long period of time.
Forecast:	By collecting meteorological data, like air temperature, pressure, humidity, solar radiation, wind speeds and direction etc.	By aggregates of weather statistics over periods of 30 years
Determining factors:	Real-time measurements of atmospheric pressure, temperature, wind speed and direction, humidity, precipitation, cloud cover, and other variables	Aggregating weather statistics over periods of 30 years ("climate normals").
About:	Weather is the day-to-day state of the atmosphere, and its short-term (minutes to weeks) variation	Climate is defined as statistical weather information that describes the variation of weather at a given place for a specified interval.
Time period:	Measured for short term	Measured over a long period
Study:	Meteorology	Climatology

The practice of silviculture aims at utilising the site factors in such a way so that production is maximum. Light is an important factor as it play significant role in:

a. Obtaining natural regeneration and
b. Obtaining maximum production of high quality wood.

For natural regeneration, it is essential that some light reaches ground level. Better light conditions are required for the growth and development of seedling. Several Silvicultural practices are adopted for maximum volume production of quality wood. These are:

- The crop up to the pole stage is allowed to grow under some congestion so that lower branches of trees do not get sufficient light due to the shade created by upper branches or canopy resulting in the death of lower branches. This gives a long clean bole due to natural pruning.
- When the tree crown is restricted at the upper part of the tree, it results in the development of more cylindrical stem form.
- Increased growth rate is obtained in trees exposing them to favourable light condition. This behaviour of trees towards light has been successfully utilised in Forestry. The light stimulus given by creating a heavy opening in the crop , towards the end of its life, after trees have been raised in closed crop results in rapid volume increment. Such increment is usually called “Light Increment’

Light requirement influences the choice of Silvicultural practices. A traditional distinction is drawn between light demanding, intermediate and shade tolerant species on the basis of the amount of shade that seedlings can tolerate while still making effective growth. Those which are shade tolerant can be expected to grow in small gaps (0.05 ha or less) or under the canopy of a mature stand whereas light-demanding species will require very light canopies or open areas to achieve adequate growth. Intermediate species are those that can regenerate under a canopy, but require this to be opened up rapidly to ensure good seedling growth. Seedlings of all species can occur underneath an overstorey as 'advance regeneration', but only shade tolerant species can survive and grow for any length of time beneath a canopy. Therefore species in the shade tolerant category such as beech and Norway spruce are suitable for selection systems while those such as birch and Scots pine are favoured by seed tree systems.

In light demanders the carbon assimilation increases rapidly with increase in the light intensity, subsequently reaches the maximum and then remains constant. In shade bearing species, on the other hand, the maximum for carbon assimilation reaches early; and then there is no further increase in the photosynthetic activity. (Fig. 1.)

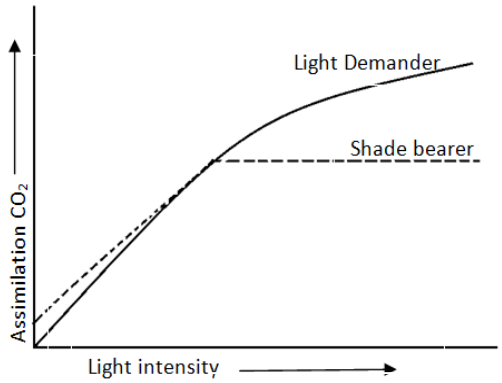

Fig. 1

Q3.What is regeneration felling. Describe the processes on which natural regeneration of the forest depends and recommend important operations to ensure its success.

Ans:-

Regeneration felling is defined as felling carried out between seeding felling and final felling under a Shelterwood system in order to remove the shelter and admit increasing light to the regenerated crop

Natural regeneration is possibly by following two ways:-

1. Natural regeneration by seeds
2. natural regeneration from vegetative parts

Successful natural regeneration from seed depends upon the success of the following four processes:

a. Seed production: it depends upon various factors such as species, age of the tree, site, weather condition, attack of insects and fungi etc. seed production in a tree varies from year to year. E.g. *Tectona grandis*, *Dalbergia sisso* and *Acacia nilotica* seed well practically every year. Some other species e.g. *Shorea robusta*, *Terminalia alata* etc. seed well in alternate years while several other species eg. *Abies pindrow* and *Anogeissus latifolia* do so only after long intervals.

b. Seed dissemination: For the continued existence of a species, it is necessary that seeds are carried away from the parent plant, because seeds germinating immediately below the parent tree commonly do not get established. Seed dissemination gives the young seedlings a better chance of survival for they are saved to a large extend from competition with the parent tree. The means of dispersal adopted by the seeds of different species vary widely. The four important agencies by which seed dispersal is secured are:-
    1. wind
    2. water
    3. animals and
    4. Explosive mechanism or ejection mechanism in fruit itself.

c. Seed germination:- In general , successful germination of a good seed depends upon moisture, proper temperature and the nature of the soil where it falls. In some cases light is also required for germination eg. In Rhododendron spp., *Albizia procera, Cassia fistula* etc.
d. Establishment of seedling:- The success of natural regeneration depends generally on achain of processes viz. Sufficient seed production, proper and efficient dissemination, good seed germination and establishment of seedlings in sufficient numbers. Successful establishment of newly germinated seedlings in sufficient number as a member of forest crop is undoubtly, the weakest link in the whole chain of processes which make up the regeneration of the forest crop.

Natural regeneration by coppice depends on the formation of adventitious buds from the callus tissues around the wound and growth of dominant buds which already exist. Both type of buds require some stimulus to produce new shoots like physiological imbalance during injury, cutting. On the basis of species coppicing power they are classified into :

Strong Coppicers	**Fair Coppicers**	**Poor Coppicers**	**Non- Coppicers**
Acacia catechu, Albizia spp., Anogeissus latifolia, Butea monosperma, Dalbergia sisso, Eucalyptus globules etc.	*Terminalia alata, Terminalia bellerica, Pterocarpus marsupium* etc.	*Acacia nilotica, Adina cordifolia, Madhuca indica, Bombax ceiba* etc.	*Pinus* spp., *Cedrus deodara, Picea smithiana, Abies pindrow* etc.

Natural regeneration by root suckers depends on its formation as it is induced by felling of the parent plant or by inflicting injury to the roots as in *Dalbergia sisso, Dalbergia latifolia, Bombax ceiba* etc. They may occur naturally as in *Butea monosperma, Anogeissus latifolia, Diospyros melanoxylon* etc.
To ensure successful natural regeneration the following operation can be recommended:-

i. Manipulation of upper canopy.
ii. Manipulation of lower canopy
iii. Treatment to ground vegetation
iv. Soil working
v. Controlled grazing
vi. Controlled fire
vii. Slash disposal
viii. Direct seeding in patches
ix. Protection

Q4.Define Universal Law given by Frederic E. Clements. Compare the climax theory given by him with others in detail.

Ans:

According to Universal Law given by Frederic E. Clements, all bare places give rise to new communities except those which are present in the most extreme conditions of water, temperature, light or soil.

Clements believed that if in given indefinite time without disturbance to the communities in a given climatic region, climax would approach the same composition and structure i.e. this theory (Mono climax theory) recognises only one climax determined solely by climate, no matters how great variation in other environmental conditions exists in an area. The theory points that all seral communities in a given region, if allowed sufficient time would ultimately converge to a more less single stable form of climax community. All communities other than the climax are related to climax by successional development and are recognized as seral, sub climax, disclimax, preclimax, climax and post-climax. Whereas climax theory given by Tansley in 1935 (Polyclimax theory) considers that the climax vegetation of region consists of not just one type but a mosac of vegetational climaxes controlled by soil, moisture, nutrients, topography, slope, aspect, fire, grazing etc. according to this concept each stable community within a climate is called a climax community. when the development is due to climate, they are described as climatic climax, when it is due to edaphic conditions they are called edaphic climax when formation of vegetation is due to topography, topographic climax, when biotic factors control the development of vegetation, they are biotic climax. However the theory

proposed by Fosberg (1967) and Odum (1969) considers the succession and climax in terms of ecosystem development. According to this theory succession is a function of energy balance and nutrient cycles. The climax stage is reached when the amount of energy and nutrients received from the environment by the vegetation is returned in more or less similar amount to the environment by the decomposititon through heterotrophs. In autotrophic succession, diversity of species tends to increase with an increase in organic content and biomass supported by the available energy. In a heterotrophic succession, there is a gradual depletion of energy because the rate of respiration is always more than the production. In a ecosystem, both autotrophic and heterotrophic succession operate in a coordinated manner.

Q5.write shorts notes on the following:

i) Principle of Silviculture

ANS:

Silviculture is defined as "The art and science of cultivating forest crops" (Indian Forest and Forest Products Terminology)

Silvics is the study of life history and general characteristics of forest trees and crops with particular reference to environmental factors, as the basis for the practice of silviculture.

- Silviculture includes both silvics and their practical application.
- Silviculture is not a purely biological science which has no relation with economics.

Objectives of Silviculture:

1. *Production of species of economic value:* In the virgin forest, many species are generally neither very valuable nor useful. Therefore production of timber of species of economic value per unit area is low. It the forests have to produce timber of industrial and economic importance, it is necessary to study and practice silviculture so that we can produce only the desired species.
2. *Production of larger volume per unit area:* In the virgin forest, the crop is generally either very dense or very open. Both these extremes are unsuitable for quantitative production. If the crop is very dense, the growth of the individual trees is adversely affected resulting in lesser timber production per unit area. On the other hand, if the crop is very open, the number of trees, and consequently volume, per unit area would be less. The study and practice of silviculture helps in raising sufficient trees per unit area right from the beginning to fully utilize the soil and prevent the heavy loss due to competition and consequently further increase the volume.
3. *Production of quality timber :*
   In the unmanaged forest, because of intense competition, a large number of the trees become crooked, malformed, diseased and defective. This result in the deterioration of the quality of timber produced. If the production of quality timber is to be ensured, knowledge of silviculture will be essential so that the trees can be grown in disease free condition without adverse competition.
4. *Reduction of rotation:-*
   In the virgin forests because of intense competition in the dense parts the rate of growth of the individual tree is retarded with the result that it takes longer time to reach the size at which it can be exploited. This increases the cost of production of timber with the knowledge and practical; application of silviculture, the density crop can be properly regulated and consequently the rate of growth increased and rotation reduced.
5. *Raising forests in blank areas:-*
   In nature, a large number of areas, potentially suitable for tree growth, occasionally remain blank due to certain adverse factors in habiting growth of trees.
6. *Creation of man-made forests in place of natural forest:-*

There may be area in natural forests which may not regenerate or reproduce themselves naturally or where natural regeneration may be extremely slow and uncertain. In such areas, it becomes necessary for the foresters to take up the work of the nature in his hand and raise man made forests in such areas.

7. *Introduction of exotics:-*

The indigenous species may not be able to meet the commercial and/or industrial demands. In such areas, efforts are made to introduce exotic which can grow in that particular locality and can supply the timber required by the industries etc. in time. For example, the demand of paper is increasing very fast. There is no indigenous species which may grow in a variety of sites easily and very fast so that demand of paper pulp industry may be met. Therefore, a fast growing exotic, *Eucalyptus hybrid*, had to be introduced.

ii) Cleaning

ANS: Cleaning is defined as a tending operation done in a sapling crop which involves removal of inferior growth including individuals of favoured species.

Objects of cleaning:

1. To improve light conditions
2. To reduce root competition
3. To reduce transpirational water loss

Methods:

1. **Mechanical methods-** Most common method is cutting the inferior growth with the help of sharp implements eg. Axe, spade etc.

2. **Biological methods-** use of suitable cover crops, maintenance of proper stand density, use of suitable degree of fire, grazing and use of insect pest which may feed on weeds are tried. Eg. In Karnataka , Amaranthus spp. Used as cover crop in moist Deciduous teak forest. Lantana bug (*Orthezia insignis*) has been used to contoll notorious *Lantana camera*

3. **Chemical methods**-use of suitable cover crops, maintenance of proper stand density, use of suitable degree of fire, grazing and use of insect pest which may feed on weeds are tried. Eg. In Karnataka , Amaranthus spp. Used as cover crop in moist Desiduous teak forest. Lantana bug (*Orthezia insignis*) has been used to control notorious *Lantana camera*

The intensity and interval of cleaning operation have to be decided taking into consideration the growth behaviour of the species, site condition and economic factors.

Eg. For obtaining sal regeneration in moist type sal forest, repeated cutting of *Mallotus philippensis*, *Clerodendron viscosum* etc. are necessary.

iii) Tolerance

ANS:

This is an important concept in silviculture which is generally defined as the ability or capacity of a tree to develop and grow in the shade of and in competition with other trees. Species are generally ranked by the broad classification of being either tolerant or intolerant. Understanding species tolerance is very important when we make forest management prescriptions. If our goal is to establish or maintain a very intolerant species, we must provide full sunlight conditions, typically by clearcutting the stand at harvest time. If, on the other hand, we want to foster very tolerant species, we usually prescribe a partial or selection harvest. Intermediate species usually benefit from open shade that is obtained by a shelterwood harvest.

Criteria for estimating tolerance of trees:-

1. **Condition of reproduction:-** Reproduction of a species under varying canopy covers and competitive conditions is probably the most widely used and reasonably reliable way of evaluating its tolerance. It is deficient in requirements can be judge from its regeneration but it is in effective for comparing the relative tolerance of two non associated species.
   Eg. Douglas fir can have a relative tolerance varying throughout its range from tolerant to intolerant depending on whether it is associated with Penderosa pine & Larch or Hemlock & western red cedar.
2. **The density of the crown:-** Intolerant species have relatively thin foliage and open crown & canopy or low leaf area index where as tolerant species have thick dense crowns and canopy cover or high leaf area index
   Eg. Aspen, yellow poplar and vine maple have "staggered" placement of leaves to maximize light interception.
3. **Juvenile height growth:-** Juvenile height growth tends to be more rapid in intolerant trees than in associated tolerant species when grown in open. It is observed that after seedling stage, tolerant trees grow faster in the open than they do in the shade.
4. **Self Pruning:-** It is useful in separating the extremes of tolerance if allowances are made for stand density. Tolerant trees clean their boles of side branches relatively slowly since their leaves remain functioning in low light and keep the twigs and branches alive. Intolerant species clean their trunks more rapidly some time even when growing in an isolated position in full light like long leaf pine. They tend therefore to yield a higher proportion of clear lumber when grown to an old age in wild or poorly manage stand.
5. **Number of branch order or the length of time the leaves are retained on tree:** the tolerant species have more branch order than intolerant species but in conifers it is difficult to apply since the range in number of orders lies usually 4-8 in tolerant while intolerant species is very narrow. Example bristlecone pine is very intolerant yet it retains its leaf for 15-20 years or more.
6. **Natural thinning:** natural thinning is faster for intolerant species if the stand has not stagnated. An overly dense stand the most species will stagnate in growth for a period and the more tolerant species the sooner some individual will gain dominance. Stagnation can be for long period and some species like lodgepole pine seem unable to generate dominance. Example the densest plot found in a stagnated lodgepole pine stand had 264000 trees per hectare at 70 years with height under 1.5m.
7. **Capacity for release:** it is another important difference between tolerant and intolerant species. When tolerant trees form understorey they are persistent, clinging to life inspite of very small growth for many years. When finally release they develop very well unless the suppression has been very long and severe. Whereas intolerant species die out rapidly and if released before death they often respond sluggishly to the release.
8. **Density of stem:** in fully stocked stand of tolerant species tend to be greater than in stands of intolerant trees of equal age and height.
9. **Stem taper:** in tolerant species owing to the fact that they lose their lower branches and develop more cylindrical form than tolerant trees under equal condition of stand density.
10. **Leaf structure:** tolerant leaf contains more spongy parenchyma and intolerant leaf have more palisad parenchyma.

Q6. What is the system of classification of forest? Discuss the classification on the basis of soil, climate and physiography.

Ans:-

Environment has the profoundest influence on vegetation which not only grows and develops in its environment but remains in equilibrium with it. Therefore, the system of classification of vegetation can be either:

(i) Botanical , i.e. based mainly on vegetation
(ii) Climatic i.e. based on mainly on climate; or
(iii) Ecological, i.e. based mainly on ecosystem consisting of vegetation environment complex

Champion in 1936 suggested provisional forest types for India based on locality factors like climate, topography, climate, physiography and biological factors. Taking into account additional information collected on these factors and suggestion offered by various works Champion and Seth revised the above work in 1963. On the basis of mean annual temperature, January mean temperature, the incidence of frost sand soil moisture status, five major types have been recognized.

1. Tropical Forests
2. Montane subtropical forests
3. Montane temperate forests
4. Sub-alpine forests
5. Alpine scrub

These are further divided into type groups, considering the rainfall, humidity number of rainy days, etc.

The classification of evergreen and deciduous formation is based on number of dry months in the year as well as floristic composition of the forest.

The type groups are further divided into number of sub-groups depending upon whether the foret is situated to the north or south of Tropic of Cancer or in eastern or western Himalayas. Each sub group is divided into various climax formations (designated by letter C) and in each climax formations edaphic and seral variations are described. The edaphic variations are designated by 'E' primary seres by IS and secondary seres by 2S.

REVISED FOREST TYPES OF INDIA

1. MOIST TROPICAL FORESTS
   Group 1.- Tropical Wet Evergreen Forests
   Sub- group 1A- Southern tropical wet Evergreen Forests
   C1- Giant evergreen forest
   C2-Andamans tropical evergreen forest
   E1-Andamans moist deciduous forest
   C3-southern hilltop tropical evergreen forest
   C4-west coast tropical evergreen forest
   Sub- group 1B- Northern tropical wet Evergreen Forests
   C1-Assam Valley tropical wet evergreen forest
   C2-Upper assam Valley tropical evergreen forest
   (2a) *Kayea* forest
   (2b) *Mesua* forest
   C3-Cachar tropical evergreen foret

   Group 2.- Tropical Semi- Evergreen Forests
   Sub- group 2A- Southern Semi- Evergreen Forests
   C1-Andamans Semi- Evergreen Forests
   C2-West Coast Semi- Evergreen Forests
   C3-Tirunelveli Semi- Evergreen Forests
   Sub- group 2B- Northern tropical Semi- Evergreen Forests
   C1-Assam Valley Semi- Evergreen Forests
   C2-Cachar Semi- Evergreen Forests
   C3-Orissa Semi- Evergreen Forests

   Group 3.- Tropical Moist deciduous Forests
   Group 4.- Littoral and swamp Forests

2. DRY TROPICAL FOREST
   Group 5.- Tropical Dry Deciduous Forests
   Group 6.- Tropical Thorn Forests
   Group 7.- Tropical Dry Evergreen Forest

3. MONTANE SUBTROPICAL FORESTS
   Group 8.- Subtropical Broadleaved Hill forest
   Group 9.- Subtropical Pine forest
   Group 10.- Subtropical Dry Evergreen Forests

4. MONTANE TEMPERATE FORESTS
   Group 11.- Montane Wet Temperate Forests
   Group 12.- Himalayan Moist Temperate Forests
   Group 13.- Himalayan Dry Temperate Forests

5. SUB-ALPINE FORESTS
   Group 14.- Sub-Alpine Forests

6. ALPINE SCRUB
   Group 15.- Moist-Alpine Scrub
   Group 16.- Dry-Alpine Scrub

Q7. What is the difference between jungle and forest? Forest are world's air conditioners and earth blankets, explain.

Ans:-

In general the object of study and practice of Silviculture is to produce more useful and valuable forests to meet our multifarious requirement, than nature would do and that too, in shorter time. The objects with which nature produces vegetation are not identical with that of man. The former produces a 'jungle' the latter a 'forest'. The word jungle originates from a Sanskrit word jangala, meaning "forest" whereas the word forest eventually came to mean wooded land more generally. The jungle is impenetrable while forest is penetrable.

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Forests are world's air conditioners and earth's blankets. Without forest, this world would be an inhospitable place to live in. forests are the most valuable natural renewable resources of the earth. Forest help life on earth by performing various functions are:-

- Productive
- Protective
- Ameliorative
- Recreational and
- Developmental

Productive functions of the forest:-

I. The goods provided by the forests are of immense importance to animals and mankind. Wood is a major forest produce and it is extensively used for various purposes. In India, most of wood produced is used for construction of houses, agriculture implements, bridges, sleeper etc. eg. Teak, Sal, Deodar, Sissoo, Babul, Chir, Haldu Axlewood, rosewood etc.

II. Wood is a universal fuel. For about thousands of years until the advent of coal, oil, gas, electricity, etc. wood constituted man's chief source of fuel. Even today, more than half of the total world's consumption of wood is for fuel.

III. Forest provides raw material to large number of industries e.g. Paper and pulp, plywood and other boards, saw mills, furniture making, packing cases, match and toys. Etc.

IV. A large number of non-wood products are also available from forests. These are commonaly called as minor forst procuct (MFP) not because these are of minor significance but since they are harvested in smaller quantities. Eg.

V. Fibres and flosses from senal and kapok

VI. Grasses and bamboos
VII. Essential oils from Eucalyptus, cymbopogon, santalum spp. Etc.
VIII. Oil seeds eg. Mahua, Pongamia pinnata, Shorea robusta, Azadirachta indica etc.
IX. Tans and Dyes eg. Acacia nilotica, Emblica offcinalis, Anogeissus latifolia etc.
X. Gums and resins, Gums from eg. Acacia nilotica, Anogeissus latifolia, Shorea robusta,Butea monosperma etc. and resins from Pinus roxburghii
XI. Drugs, spices and insecticides: Rauvolfia serpentine, Ephedra spp.
XII. Tendu leaves also called bidi leaves
XIII. Edible fruits, tuber seeds flowers etc.
XIV. Lac and other products

Protective and ameliorative functions:-

I. Forest plays an important role in maintaining the CO_2 balance.
II. Forest increases local precipitation by about 5 to 10 per cent due to their orographic and micro-climate effect.
III. Forest reduces temperature and increases humidity. Temperature is 3 ^{0}C to 8 ^{0}C
IV. Forest maintains productivity, reduces wind velocity, checks soil erosion etc.
V. Store house of genetic diversity.

Recreational and educational function:

I. Forest provides recreational facilities to the people. Large variety of trees and shrubs, animal and birds attracts a large number of people towards them.
II. Forest provides an experimental field and laboratory for learning to college and university students.

Development functions:-

I. Forest provides employment to large number of people.
II. Forest and various forest activities help tribals to improve their social economic condition through collection, processing and marketing etc.

Q8. Discuss the important commercial species of C.G. and write the Silviculture of any two species

Ans:- Sal (*Shorea robusta*) and Teak (*Tectona grandis*) are the two major tree species in the state. Other notable overwood species are Bija (*Pterocarpus marsupium*), Saja (*Terminalia tomentosa*), Dhawra(*Anogeissus latifolia*), Mahua (*Madhuca indica*), Tendu (*Diospyros melanoxylon*) etc. Amla (*Embilica officinalis*), Karra (*Cleistanthus collinus*) and bamboo (*Dendrocalamus strictus*) constitute a significant chunk of middle canopy of the state's forests. From the management point of view, there are four types of forests in the state of Chhattisgarh. These are Teak, Sal , Miscellaneous and Bamboo forests.

Silviculture of Teak (*Tectona grandis*)

Teak is indigenous to peninsular India. Its upper limit in Rajasthan is 24^{o}42’ N latitude and in U.P. 25^{o}33’N latitude. Thereafter it drops towards south and goes towards Mahanadi. Besides its natural

habitat, it has been raised artificially in U.P., Orissa, west Bengal and Andaman's. In its natural habitat, maximum temperature rises to 48^{o}C, minimum temperature drops to 2^{o}C and annual rainfall varies from 750mm to 5000mm. It grows on a Varity of geological formation and soil derived from them. It granite, gneiss and schist but does not grows well on trap because the soil is shallow. In well drained, deep alluvial soils, teak does not only grow pure but it is also attaining big size.

Leaf shedding and fruiting: - In dry situation and seasons, leaves fall from November to January while in moist localities, the tree may remain in leaf upto March or even later. The new leaves ordinarily appear from April to June according to locality and season. Flowers appear, as a rule, from June to August or September according to season and locality. Fruits ripen from November to January and fall gradually, some remaining on the tree till hot season.

Silvicultural characters:- Teak is strong light demander. It is sensitive to frost and drought. It coppices and pollard vigorously. Because of this characterstics it escapes damages from frost, drought, grazing and fire.

Natural regeneration of teak varies with circumstances. For instance, in dry and semi dry teak types, natural regeneration comes up profusely but in very dry, moist and very moist teak types natural regeneration does not come up at all or comes up scantily.

Artificial regeneration- seed ripens from November to January and weighs 1850 to 3000 fruits per kilograms. Seed is collected from below the tree after the ground has been swept clean. But colle3ction of seed from the tree is better of the two methods. As the seed coat is hard and there is a tendency for dormancy, it is necessary to given seeds some pre-treatment may be any of the following:

1. Immersion in cold water for 48 hours;
2. Immersion in boiling water which is the allowed to cool down.
3. Alternate wetting and drying
4. Scorching in light fire of leaves.

Teak is propagated by direct sowing, entire planting and stump planting. For direct sowing, the seed is sown on ridges made of weathered soil at a spacing of 3m. Sometimes, this is done by Taungya method .For planting, planting stock is raised in nursery. The nursery bed is 12m x1.2m. Generally raised beds are used but in dry areas of M.P. sunken beds are made initially and later they are made raised by depressing the path round the nursery beds. The time of sowing and quantity of seed sown per bed varies from state to state. If irrigation facility is available, treated seed is sown in March. Quantity of seed sown varies from 4 kg to 12 kg per bed. The seed is generally sown in drills 7.5cm apart but sometimes. It is also sown broadcast. The sown seed is covered with 1cm thick layer of soil. With regular watering, seed germinates in 10 to 20 days. When the seedling can be handled they are transplanted in new beds at a spacing 20cmx 20cm. In some states, transplanting is not

considered necessary. With regular weeding and watering, seedling attains a size fit for entire planting in one year. Stumps are made from seedling one to two year old when the collar diameter is 1 cm to 2 cm. Of these two stumps planting is the best. Whichever be the method, planting is done in pits 30 cm3 spaced from 2mx2m to 2.8m x 2.8m. Regular weeding is necessary. Three weeding are done in first year, 2 in second years and one in the third year.

Silviculture of Sal (*Shorea robusta*)

Sal occurs in 2 main region, viz. i) Northern region and ii) Central India region separated by Gangatic plain. In the northern region sal occurs from Kalesar in Haryana to Darang in Assam as a continuous belt. In Central India regions, Sal occurs in Bihar, West Bengal, Orissa, Madhya Pradesh and Chattissgarh. In its natural habitat , maximum temperature varies from 34 ^{o}C to 47^{o}C, minimum temperature from 10 ^{o}C to 7 ^{o}C and annual rainfall from 1020mm to 4600 mm. Sal occurs on a variety of soils formed from a variety of geological formations.

Leaf shedding and fruit:- The leaves fall from January to March but in dry seasons and in dry localities this takes place earlier. The new leaves and shoots appear from Februry to May according to locality and season. The flower buds , as arule become visible in February and continue to grow till April. The young fruits form rapidly and ripen in June and fall as soon as they ripen. The time of ripening of fruits naturally varies from locality to locality and state to state.

Silvicultural character:- Sal is a light demander. It is frost –tender and very sensitive to drought. If the soil moisture in the root zone is less than a fixed amount, the seedling is killed. It is a good coppicer upto a moderate size (i.e. 60 to 90 cm girth)

Natural regeneration:- As Sal occurs in varying climatic conditions in extensive areas, condition of natural regeneration also vary from place to place. Broadly speaking, the area with *in-situ* soils has adequate natural regeneration while the area with transported soils are problem areas so far as natural regeneration is concerned.

Artificial regeneration:- Seed ripens in May-June in West Bengal, in June in U.P. and Bihar and in May to July in M.P. Seed weighs 575 to 1000 seeds per kilogram In order to collect seed, the ground below good phenotypes is swept clean and fresh seed is collected daily for sowing and entire planting. Stump planting is tried experimentally but give low survival.