WEST BENGAL STATE UNIVERSITY

DRAFT SYLLABI STRUCTURE IN BOTANY OF THE 4-YEAR UNDERGRADUATE PROGRAMME (HONOURS) / (HONOURS WITH RESEARCH) UNDER NEP-BASED CREDIT SYSTEM

(w. e. f. 01.08.2023)

MAJOR PAPERS IN BOTANY

SEMESTER I **T+P** **50+50=100 marks**	**Major (DSC-1) BOTDSC101T+ BOTDSC101P**
DSC-1 **BOTDSC101T** **Microbiology and Phycology** **(30+20)=50 marks**	**THEORY: 50 marks** **Microbiology - 30 Marks** **(30 lectures)** **Unit 1:** Introduction to the microbial world Binomial nomenclature, difference between Prokaryotic and Eukaryotic microorganisms, development of microbiology as a discipline, spontaneous generation vs biogenesis, contribution of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming. Primary concept of microorganism – 3 domain concept. **Unit 2:** Viruses Physiochemical and biological characteristics; general structure with special reference to subviral particles (Satellite virus, Viroids and Prions); groups of virus, DNA virus (T-phage, λ phage), lytic and lysogenic cycle, RNA virus (TMV) – physico-chemical characteristics and its mode of multiplication. **Unit 3:** Bacteria General characteristics, Microbial nutrition, growth and metabolism. Types - archaebacteria, eubacteria, and mycoplasma; cell structure; nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). **Unit 4:** Industrial and Environmental Microbiology Bioreactors/Fermenters and fermentation processes, different types of fermentation processes, parts of Fermenters and their functions, downstream processing and industrial production of ethanol, penicillin, citric acid and amylase. Economic importance of bacteria with reference to their role in agriculture and role of viruses in vaccines. **Unit 5:** Microbes and quality of environment Distribution of microbes in air, water and soil; water pollution, role of microbes in sewage and domestic waste water systems; Microorganisms as indicator of water quality; Microbes in agriculture and remediation of contaminated soil. **Phycology - 20 Marks** (20 lectures) **Unit 1:** General characteristics; ecology and distribution; range of thallus organization; cell structure and components; cell wall, pigment system, reserve food (only groups represented in the syllabus), flagella and flagellar roots;

	methods of reproduction; classification; criteria, evolution of sex in algae; SET (serial endo symbiotic) theory; classification of Lee 2018 (only up to class); significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, M.O.P. Iyengar). **Unit 2:** Cyanophyta and Xanthophyta Ecology and occurrence; range of thallus organization; cell structure; reproduction, morphology and life-cycle of *Nostoc* and *Vaucheria*. **Unit 3**: Chlorophyta and Charophyta General characteristics; occurrence; range of thallus organization; cell structure; reproduction. Morphology and life-cycles of *Volvox, Oedogonium*, *Chara*. Evolutionary significance of Prochloron. **Unit 4:** Bacillariophyta General characteristics; occurrence; range of thallus organization; cell structure; reproduction and life cycle of Diatom. Economic importance. **Unit 5:** Phaeophyta and Rhodophyta Characteristics; occurrence; range of thallus organization; cell structure; reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and *Polysiphonia*. **Unit 6:** Applied Phycology Role of algae in environment, agriculture, biotechnology, biofuels, industry and bioremediation.
DSC-1 **BOTDSC101P** **Microbiology (5+5)+15 marks and Phycology (5+5)+15 marks Total (10+10)+30=50 marks**	**Practical 50 marks** **Microbiology – 25 marks** **1.** Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle. **2.**Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root nodule. **3.** Demonstration of the preparation of media, sterilization and sub culturing. **4.** Gram staining of bacteria from curd sample; Endospore staining with malachite green using the (endospores taken from soil bacteria). **5**. Principles and functioning of instruments in microbiology laboratory **6**. Hands on sterilization techniques and preparation of culture media. 7. Isolation of bacteria from soil, water and air; Isolation of antibiotic producing microbes from soil; Determination of BOD, COD, TDS and TOC of water sample. **8.** Visit to any educational institute/ industry to see an industrial fermenter, **Phycology – 25 marks** **9.** Study of vegetative and reproductive structures of *Nostoc, Volvox, Oedogonium, Chara, Vaucheria, Ectocarpus, Fucus* (Preserve specimen/ permanent slides) *and Polysiphonia,* through temporary preparations and permanent slides. *Prochloron* through electron micrographs.

	10. Illustration through drawing prism with magnification of vegetative and reproductive structure of *Oedogonium, Chara, Vaucheria*. **Suggested Readings** **Microbiology** 1. Atlas, R.M……. Principles of Microbiology [McGraw Hill] 2. Willey, M.J., Sherwood, L.M. &Woolverton, C.J...rescot, Harley and Klein's…… Microbiology[McGraw Hill] 3. Madigan, M.T., Martinko, J.M. &Parker, J. Brock….. Biology of Microorganisms [Prentice Hall] 4. Tortora, G.J., Funke, B.R. & Case, C.L……. Microbiology - An Introduction [Dorling Kindersley India Pvt. Ltd. for Pearson Education]) 5. Pelczar, M.J., Chan, P.C.S. & Krieg, N.R.Microbiology [Tata McGraw Hill] 6. Stanier, R.Y., Ingraham, J.L., Wheelis,M.L. &Painter, P.R…… General Microbiology [Macmillan Education Ltd.] 7. Banerjee, A.K. & Banerjee, N. ……Fundamentals of Microbiology and Immunology [New Central Book Agency] 8. Dey, N.C., Dey, T.K. & Sinha, D……. Medical Bacteriology.Mycology.... NCBA] **Phycology** 1. Chapman, V.J. & Chapman, D.J…… The Algae [Macmillan,London] 2. Lee, R.E. 2015..edition 5……...Phycology [Cambridge Univ. Press] 3. Kumar, H.D. &Singh, HN……. Introductory Phycology [East-West Press Pvt. Ltd] 4. Sharma, O.P…….. Text Book of Algae [(Tata McGraw Hill] 5. Smith, G.M……. Cryptogamic Botany Vol. 1 [McGraw Hill] 6. Vashistha, B.R., Singh, A.K. & Singh, V.P.....Algae [S. Chand & Co. Pvt. Ltd.] 7. Bold, H.C. &Wynne, M.J. .....Introduction to Algae: Structure &Reproduction [Prentice Hall]) 8. Ganguly, H.C. & Kar, A.K.....College Botany Vol.-I [New Central Book Agency] 9. Chopra, G.L. ……..A text book of Algae [S. Nagin & Co. New Delhi] 10. Hoek, C. Mann, D.G. & Jahns, H.M. 1995 .....Algae [Cambridge Univ. Press]

SEMESTER II **T+P** **50+50=100 marks**	**Major (DSC-2) BOTDSC202T+ BOTDSC202P**
DSC-2 **Course Code:** **BOTDSC202T** **Mycology** **Phytopathology** **(25+25)=50 marks**	**Theory: 50 marks** **Fungi-25 Marks** **(25 Lectures)** **Unit 1:** Introduction to true fungi General characteristics; affinities with plants and animals; idea of Fungi as a separate kingdom of life; thallus organization; cell wall composition; nutrition; sexual (with reference to sporocarp) and asexual (spore forming bodies in deuteromycetes) reproduction; classification (Hawksworth et al 1995). Concepts of Molecular identification, Barcoding and Tree of Life. **Unit 2:** Chytridiomycota and Zygomycota Characteristic features; ecology and significance; thallus organisation; reproduction; life cycle with reference to *Synchytrium, Rhizopus*. **Unit 3:** Ascomycota General characteristics (asexual and sexual fruiting bodies); ecology; life cycle, heterokaryosis and parasexuality; life cycle with reference to *Saccharomyces, Penicillium, Neurospora, Ascobolus.* **Unit 4:** Basidiomycota General characteristics; ecology; black stem rust of wheat, life cycle with reference to spore forms; concept of macrocylic, microcyclic, demicyclic, heteroecious, autoecious rusts. *Puccinia* (physiological specialization), Loose and covered smut (symptoms only). *Agaricus*; bioluminescence, fairy rings and mushroom cultivation (general account). **Unit 5:** Allied Fungi General characteristics; status of slime molds; occurrence; types of plasmodia; types of fruiting bodies. **Unit 6:** Oomycota General characteristics; ecology; life cycle and classification, concept as a separate kingdom of life with reference to *Phytophthora, Saprolegnia.* **Unit 7:** Symbiotic associations Lichen – Occurrence; general characteristics; growth forms and range of thallus organization; nature of associations of algal and fungal partners;

	reproduction; ecological and economic significance; Mycorrhiza - ectomycorrhiza, endomycorrhiza and their significance. **Unit 8:** Applied Mycology Role of fungi in biotechnology; application of fungi in food industry (flavour & texture, fermentation, baking, organic acids, enzymes, mycoproteins); secondary metabolites (pharmaceutical preparations); agriculture (biofertilizers); mycotoxins; biological control (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides); medical mycology. **Phytopathology- 25** (25 lectures) **Unit 9**: Definitions and Concepts of plant disease: Parasite, Pathogen and Vector, Inoculum and Inoculum density, Infection, Susceptibility and Virulence, Etiology; symptoms - types; necrotroph, biotroph & hemibiotroph; disease, disease types, disease triangle, disease cycle (monocyclic & polycyclic); sporadic, endemic, epidemic and pandemic diseases with examples that had significant impact in human history; Koch's Postulates. **Unit 10:** Host - Parasite Interaction: recognition concept and infection. Disease development - role of enzymes, toxins, growth regulators. Defense strategies - structural and biochemical mechanisms (Constitutive and Induced). Roles of Phytoalexins, Phytoanticipins & PR proteins, elicitors, HR response. Genetics of Plant - Pathogen interaction - Flor's gene for gene hypothesis, Concept of R gene, Avr gene and Effectors. Resistance – systemic acquired and induced systemic resistance. **Unit 11:** Disease Management: Chemical, Biological, Cultural & Integrated management methods; quarantine; disease diagnosis, disease clinics. **Unit 12:** Prevention and control of plant disease and role of quarantine. Casual organism, disease cycle and management of bacterial diseases – *Citrus* canker, Ralstonia wilt of Tomato; Viral diseases – Tobacco Mosaic virus; Fungal and Oomycete diseases – Early and Late blight of potato, Black stem rust of wheat, Blast of Rice, Downy Mildews (*Pseudoperonospora cubensis*) and Powdery Mildew of Cucurbits (*Podosphaera xanthii*). **Unit 13**: Plant disease epidemiology- basic concepts, elements of disease, disease forecasting (preliminary ideas); Plant pathologist's contribution to crops and society.
DSC-2 **Course Code: BOTDSC202P** **Mycology (5+5)+15=25 marks** **Phytopathology (5+5)+15=25 marks**	**Practical – 50 marks** **Fungi: 25 marks** **1. Introduction to the world of fungi** (unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps) through temporary slide preparation and permanent slides.

Total (10+10)+30=50 marks	**2.** Micrometry (measurement of reproductive unit). Counting the cells per unit volume with the help of haemocytometer.(Yeast or spore). **3.** *Rhizopus* - study of asexual stage from temporary mounts and sexual structures through temporary slide preparation and permanent slides. **4.** *Penicillium* - study of asexual stage from temporary mounts and sexual stage through permanent slides. **5.** *Ascobolus* - sectioning through ascocarp. **6.** *Agaricus* - Sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms (to be shown from photographs). **7.** Lichens - study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. **8.** Mycorrhizae - ectomycorrhiza and endomycorrhiza (Photographs). **Phytopathology-25 marks** **9.** *Puccinia* - Herbarium specimens of Black Stem Rust of Wheat / Rust of *Justicia* sections; mounts of spores on wheat/*Justicia*. Permanent slides for identification of various stages. **10.** Herbarium specimens of Bacterial diseases- *Citrus* canker; Viral diseases - TMV, Vein clearing symptom from any available specimen; Fungal diseases - Early and Late blight of potato, Black stem rust of wheat and Blast of Rice, Powdery and downy mildew from any available specimen. **11.** Isolation of pathogen from diseased leaf, inoculation of fruit, demonstration of media preparation, pure culture isolation. **Suggested Readings** **Mycology and Phytopathology** 1. Ainsworth, G.C., Sparrow, F.K. and Sussman, A.S. (Eds)....The Fungi: An Advanced Treatise Vol. IVA & B, (Academic Press] 2. Hawksworth, D.L., Kirk, P.M., Pegler, D.N. and Sutton, B.C. 1995...Ainsworth & Bisby's Dictionary of Fungi, 8h Ed. [CAB International] 3. Webster, J…..Introduction to Fungi [Cambridge University Press] 4. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. …..Introductory Mycology [John Wiley & Sons Inc). 5. Moore-Landecker, E…… Fundamentals of the Fungi 4th Ed [Prentice Hall] 6. Ingold, C.T. and Hudson H.J…....The biology ofthe Fungi 6" Ed [Chapman & Hall] 7. Vashistha, B.R... …….Fungi [S. Chand & Co. Ltd.] 8. Sharma, P.D…….Fungi and Allied Organisms [Narosa Pub. House] 9. Ganguly, H.C. and Kar, A.K....College Botany Vol. II[New Central Book Agency] 10. Chopra, G.L. and Verma, V……..A text Book of Fungi [Pradeep Publication] 11. Agrios, G.N. (2006)…… Plant Pathology, 6th edition, Academic Press, U.K. 12. H. S. Chaube and V. S. Pundhir.(2009)…….. Crop Diseases and their Management. Prentice Hall (India).

SEMESTER III **T+P** **50+50=100 marks**	**Major (DSC-3) BOTDSC303T+ BOTDSC303P**
DSC-3 **Course Code:** **BOTDSC303T** **Archegoniatae I** **[Bryophytes, Pteridophytes]** **(25+25)=50 marks**	**THEORY:50marks** **(Lectures 50)** **Bryophytes-25** **(25 lectures)** **Unit 1:** Introduction Unifying features of archegoniates; transition to land habit; alternation of generations. **Unit 2:** Bryophytes General characteristics; adaptations to land habit; classification in eds book by Goffinet and Shaw 2009 (up to class); range of thallus organization. **Unit 3:** Type studies - Bryophytes Systematic position, morphology, anatomy and reproduction of *Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum* and *Funaria;* reproduction and evolutionary trends in Bryophytes (sporophyte and gametophyte) **Unit 4:** Ecological and economic importance of bryophytes; environmental Indicator and pollution indicator. Model plant - *Physcomitrium patens*. **Pteridophytes - 25** **(25 lectures)** **Unit 5:** General characteristics; classification – earlier concept by Pichi Sermolli; modern concept-molecular phylogeny; pteridophyte phylogeny group I 2016; early land plants - *Aglaophyton, Rhynia, Cooksonia, Lepidodendron, Calamites.* **Unit 6:** Type Studies- Pteridophytes Systematic position, morphology, anatomy and reproduction of *Psilotum, Lycopodium, Selaginella, Equisetum Pteris* and *Marsilea* (developmental details not to be included). **Unit 7**: Apogamy and apospory, Heterospory and origin of seed habit, telome theory, stelar evolution; ecological and economic importance; fern gametophyte and sporophyte culture and uses. Model plant *Ceratopteris*.
DSC-3 **Course Code:** **BOTDSC303P** **Archegoniatae I** **(10+10)+30=50 marks**	**PRACTICAL** **50 marks** **Bryophytes** 1. *Riccia* – Morphology of thallus. 2. *Marchantia* - Morphology of thallus, whole mount of rhizoids & scales, vertical section of thallus through gemma cup, whole mount of gemmae (all

	temporary slides), vertical section of antheridiophore, archegoniophore, longitudinal section of sporophyte through temporary slides. 3. *Anthoceros* - Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella), vertical section of thallus through temporary and permanent slides. 4. *Sphagnum* - Morphology of plant, whole mount of leaf (permanent slide only). 5. *Funaria* - Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores, longitudinal section of capsule (temporary slides); permanent slides showing antheridial and archegonial heads. **Pteridophytes** 1. *Psilotum* - Study from preserved specimen- transverse section of synangium (permanent slide). 2. *Selaginella* - Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide). 3. *Equisetum* - Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (temporary slide). 4. *Pteris* - Morphology, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), 5. One Botanical excursion to an appropriate location and time schedule to be suitably adjusted. **Suggested Readings** **Bryophytes** 1. Parihar, N.S.-Introduction to Embryophyta: Vol. I Bryophyta [Central Book Depot] 2. Rashid, A. .....An Introduction to Bryophyta [Vikas Publishing House] 3. Vashishta, B.R. .....Bryophyta [S. Chand & Co.] 4. Ganguly, H.C. & Kar, A.K. .....College Botany Vol. II [New Central Book Agency] 5. Chopra, R.N. & Kumar, P.K. .....Biology of Bryophyte [Wiley Eastern] 6. Puri, P. ..... .Bryophyte [Atmaram & Son 7. Bryophyte Biology 2009 Goffinet and Shaw eds **Pteridophytes** 1. Sporne, K.R. .....The morphology of Pteridophytes [Hutchinson & Co.] 2. Vasishta, P.C. .....Pteridophyta [S. Chand & Co.]

	3. Gifford, E.M. & Foster, A.S. .....Morphology and Evolution of Vascular Plants [Freeman & Co.] 4. Mukherjee, R.N. & Chakraborty, K. .....An Introduction to Vascular Cryptogams (Pteridophytes) [Kalyani Publishers] 5. Ganguly, H.C. & Kar, A.K. .....College Botany Vol. II [New Central Book Agency]

SEMESTER IV **T+P=400 marks**	**Major (DSC-4) BOTDSC404T+BOTDSC404P** **Major (DSC-5) BOTDSC405T+BOTDSC405P** **Major (DSC-6) BOTDSC406T+BOTDSC406P** **Major (DSC-7) BOTDSC407T+BOTDSC407P**
DSC-4 **Course Code:** **BOTDSC404T** **Archegoniatae II** **[Gymnosperms, Paleobotany, Palynology]** **(20+15+15)=50 marks**	**THEORY: 50 marks** **(Lectures: 50)** **Gymnosperms - 20** **(20 lectures)** Unit 1: General characteristics; classification of Bhatnagar and Maitra 2013 (up to family), morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum (developmental details not to be included); ecological and economic importance; evolutionary significance of gymnosperm with special reference to progymnospermopsida, Lyginopteridales, Cordaitales, Glossopteridales and Bennetitales; distribution of extant taxa; conservation strategy of gymnosperm. **Paleobotany: 15 marks** **(15 lectures)** Unit 1: Fossils - Definition, Types and mode of preservation; conditions for fossilization; Palaeobotany - a brief idea about its application. Unit 2: Geological time scale and major events of plant life through geological ages. Unit 3: Indian Gondwana system, 3-fold division with major mega-fossil assemblages. Unit 4: Plate-tectonic movement (brief concept), continental drift theory. Unit 5: Principles of fossil dating (a brief idea); - radioactive dating (Uranium, Lead, Potassium-Argon, Radio - Carbon and fission track dating. **Palynology: 15 marks** **(15 lectures)** **Unit 1:** Basic concept; spore & pollen; polarity, symmetry, shape and size, aperture types, pollen wall – chemical nature, stratification & ornamentation;

	(i) NPC classification; (ii) Application of Palynology (iii) Basic concepts of Aeropalynology, Melissopalynology, Palaeopalynology and Forensic palynology (brief idea and application).
DSC-4 **BOTDSC404P** **Archegoniatae II** **[Gymnosperms, Paleobotany, Palynology]** **(10+10)+30=50 marks**	**Practical – 50 marks** **Gymnosperms** 1**.** *Cycas* **-** Morphology and TS of leaflet, morphology of microsporophyll and megasporophyll (temporary slides) whole mount of spore (temporary slides); TS of coralloid root, LS of ovule (all permanent slide). of spores (temporary slides), 2. *Pinus* - Morphology of long and dwarf shoots, male and female cones, transverse section of needle (temporary slide), LS of male cone and female cone (permanent slide); microspores (permanent slides), 3. *Gnetum* - Morphology (shoot, male & female cones), VS of ovule (permanent slide). **4. One long Botanical excursion to an appropriate location and time schedule to be suitably adjusted**. **Palaeobotany** 1. Study from permanent slides – T.S. of stem of *Rhynia, Calamites, Lyginopteris*, 2. Study of some megafossils – *Ptilophyllum* and *Glossopteris* leaves, *Vertebraria* root system. **Palynology** 1. Study of dispersal unit of spore and pollen (slide/photograph) - monad – *Sena* (*Cassia*), tetrad-(Pteridophyte), polyad-(Mimosaceae),Pollinia (Asclepiadaceae, Orchidaceae) 2. Spore, pollen morphological study of some Pteridophytes, Gymnosperms and Angiosperms, fresh and dry specimens. 3. Pollen viability – by sucrose and $Ba(OH)_2$ solution and calculation of percentage of germination. **Suggested Readings** **Gymnosperms** 1. Sporne, K.R. ...The Morphology of Gymnosperms [Hutchinson University Library] 2. Vasishta, P.C. .....Gymnosperms [S. Chand & Co.] 3. Bhatnagar, S.P. & Moitra, A. .....Gymnosperms [New Age International] 4. Gifford, E.M. & Foster, A.S. ...Morphology and Evolution of Vascular Plants [Freeman & Co.] 5. Chamberlain, C.J. ...Gymnosperms: Structure & Evolution[CBS Publishers...] 6. Ganguly, H.C. & Kar, A.K. .....College Botany Vol. II [New Central Book Agency**]**

	Palaeobotany **1**. Arnold, C.R. .....An Introduction to Palaeobotany [Agrobios India] 2. Andrews, Jr. H.N. .....Studies in Paleobotany [John Wiley & Sons Inc.] 3. Stewart, W.N. & Rothwell, G.W...Paleobotany and evolution of plants [CambridgeUniversity Press] 4. Agashe, S.N. .....Palaeobotany [Oxford & IBH] 5.Taylor, T.N. .....Paleobotany-An introduction to fossil plant biology [McGraw Hill] 6. Meyen, S.V. .....Fundamentals of Palaeobotany [Chapman & Hall] **Palynology** 1. Mehra, P.N. .....Evolution of spore through the ages [Palynological Society of India, National Botanic Garden, Lucknow] 2. Nair, P.K.K. .....Pollen Morphology of Angiosperms [Scholar Publication] 3. Erdtman, G. ....Pollen Morphology and Plant Taxonomy [Ielden: E.G. Brill] 4. Faegri, K. & Iverson, J. .....Text Book of Pollen Analysis [Oxford: Blackwell Scientific Publication]
DSC-5 **BOTDSC405T** **Economic Botany, Ethnobotany& Pharmacognosy (25+15+10)=50 marks**	**THEORY: 50 marks** **Lectures: 50** **Economic Botany: 25 marks** **(25 Lectures)** **Unit 1:** Origin of Cultivated Plants Concept of centres of origin, their importance with reference to Vavilov's work; examples of major plant introductions; **Unit 2:** Cereals Rice- origin, morphology, cultivation & uses; brief account on millets. **Unit 3:** Legumes Origin, morphology and uses of Chick pea; importance to man and ecosystem. **Unit 4:** Sources of sugars and starches Morphology of sugarcane; products and by-products of sugarcane industry. **Unit 5:** Spices Economic importance with special reference to saffron, clove and black pepper **Unit 6:** Beverages Tea and coffee - morphology, processing & uses. **Unit 7:** Sources of oils and fats General description, classification, their uses and health implications of sesame, mustard and coconut (botanical name, family & uses).

	Essential oils – *Santalum* and *Citronella* general account. **Unit 8:** Natural Rubber Para-rubber, tapping, processing and uses. **Unit 9:** Drug yielding plants Therapeutic and habit-forming drugs with special reference to *Cinchona*, and Cannabis; Tobacco - health hazards. **Unit 10:** Timber plants General account with special reference to Teak (*Tectona grandis*), Sal (*Shorea robusta*). **Unit 11:** Fibres Classification of fibres based on the origin; Cotton, Jute, and Alied fibres;Uses of cotton and Jute. **Ethnobotany -15 marks (15 classes)** **Unit 1:** Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science; Some important Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. **Unit 2:** Role of ethnobotany in modern Medicine Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and uses) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo.* d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Validation of ethnobotanical sources in modern medicine. **Unit 3:** Ethnobotany and legal aspects: Biopiracy, Intellectual Property Rights and Traditional Knowledge. **Pharmacognosy -10 marks (Lectures: 10)** **Unit 1:** General account: Pharmacognosy and its importance in modern medicine; Crude drugs; Pharmacological and chemical classification of drugs; Drug evaluations- (Definitions with examples of the following) - organoleptic, microscopic, chemical & physical; Bioassay of drug –Adulterance, definitions and examples **Unit 2:** Secondary metabolites of plants: - Definitions and difference in between, Primary and Secondary Metabolites; Utilization of major types of metabolites as drug - phenolics & quinones, terpenoids, flavonoids and alkaloids. **Unit 3:** Active constituents: - Source plants, parts used, chemical nature & uses of the following - Glycosidic anthraquinone (Barbaloin); Tannic acid derivative (Catechin); Resins (Gingerol, Curcuminoids); Steroids (Diosgenin, Digitoxin); Alkaloids (Quinine, Strychnine, Reserpine, Vinblastine).
DSC-5 **BOTDSC405P** **Economic Botany, Ethnobotany& Pharmacognosy** **(10+10)+30=50 marks**	**Practical** **Economic Botany** 1. Cereals - Rice habit sketch with morphology- micro-chemical tests – iodine spot test.

	2. Legumes – chickpea habit scetch and morphology - micro-chemical tests (Millon test-). 3. Sources of oils and fats - coconut kernel and Mustard seeds - tests for fats (Sudan IV test). 4. Spices - black pepper and Clove - Demonstration, habit sketch and comments. 5. Essential oil-yielding plants - habit sketch of *Santalum* and *Citronella* (specimens /photographs). 6. Drug-yielding plants - Tobacco and *Cannabis.* 7. Woods – *Tectona* and *Shorea* - section of young stem specimen (permanent slides/photogtaphs). **Pharmacognosy** 1.Chemical tests for - (a) Tannin (from *Camellia sinensis* & *Terminalia chebula* - any two confirmatory tests), and (b) Alkaloids (Quinine from any drug - single test - by I_2 Soln. in KI added to the sample in acidic medium). 2. Microscopic study of powder (of parts used in drug) - Zingiber officinale and Holarrhena antidysenterica. 3. Histo-chemical tests of - (a) Curcumin (Curcuma longa), (b) Starch in non- lignified vessel (Zingiber officinale) and Alkaloids (in the stem of Catharanthus roseus and bark of Holarrhena antidysenterica). **Suggested Readings** **Economic Botany** 1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India. 2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers,The Netherlands. 3. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & BartlettPublishers. Ethnobotany 1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995. 2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981 3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow,India. 4. S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur. 5. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester 6. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah. 7.Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-19969) **Pharmacognosy** 1. Wallis, T.E .Text Book of Pharmacognosy [CBS Publishers....] 2. Evans, W.C..(G.E. Trease & W.C. Evans') Pharmacognosy [Saunders]

	3. Melentyeva, G. & Antonova, L. Pharmaceutical Chemistry [MIR Publishers] 4. Beckett, A.H...Practical Pharmaceutical Chemistry [CBS Publishers.....]
DSC-6 **BOTDSC406T** **Plant Anatomy & Embryology** **(40+10)=50 marks**	**THEORY: 50 marks** **Lectures: 50** **Plant Anatomy 40 marks (40 Lectures)** **Unit 1:** Introduction and scope of Plant Anatomy, Applications in systematics, forensics and pharmacognosy. **Unit 2:** Structure and Development of Plant Body, Internal organization of plant body; the three tissue systems, types of cells and tissues. **Unit 3:** Tissues -Classification of tissues; simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; pits and plasmodesmata; ergastic substances; hydathodes, cavities, lithocysts and laticifers. **Unit 4:** Apical meristems-Evolution of the concept of organization of the root and shoot apex. Apical cell theory, Histogen theory,Tunica Corpus theory, Korper-Kappe theory, types of vascular bundles; structure of dicot and monocot stem; structure of dicot and monocot leaf, Kranz anatomy; root cap; structure of dicot and monocot root. **Unit 5:** Vascular Cambium and Wood - Structure, function and seasonal activity of cambium; secondary growth in root and stem anomalous secondary growth- types with examples, sapwood and heartwood; ring and diffuse porous wood; early and late wood, tyloses; development and composition of periderm, rhytidome and lenticels. **Unit 6:** Adaptive and Protective Systems - Epidermal tissue system, cuticle, trichomes (uni and multicellular, glandular and nonglandular, two examples of each), stomata (classification); adcrustation and incrustation; anatomical adaptations of xerophytes and hydrophytes. **Embryology – 10 Marks (10 Lectures)** **Unit1:** Sporogenesis & Gametogenesis –Microsporogenesis & Microgametogenesis; Megasporogenesis & Megagametogenesis; Fertilization Embryo types based on development. Development of endosperm and role of polycomb genes; apomixis and its application. Polyembryony
DSC-6 **BOTDSC406P** **Plant Anatomy & Embryology** **(10+10)+30=50 marks**	**Practical** 1. Study of anatomical details of the following through permanent slides/temporary stain mounts/ macerations/museum specimens with the help of suitable representatives.

	a. Apical meristem of root, shoot and vascular cambium. b. Distribution and types of parenchyma, collenchyma and sclerenchyma. c. Xylem: Tracheary elements- tracheids, vessel elements; thickenings; perforation plates; Xylem fibres (permanent slides). d. Wood: ring porous; diffuse porous; tyloses; heart and sapwood (permanent slides). e. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres. (permanent slides). f. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular (permanent slides) g. Periderm; lenticels; C4 leaves (Kranz anatomy); Secretory tissues: cavities, lithocysts and laticifers. 2. Workout and preparation of permanent slides by following double staining method. a. Root anatomy (monocot – Orchid), dicot (Sunflower/ gram); secondary growth.anomalous secondary growth in root of *Tinospora* b. Stem anatomy (monocot- maize), (dicot – Cucurbita) - primary and secondary growth.Anomaous growth in stem of *Bignonia, Boerhavia* and *Dracaena* c. Leaf: isobilateral (Tube rose), dorsiventral (Mango), d. Adaptive anatomy: xerophytes (*Nerium* leaf), hydrophytes (*Nymphaea* petiole). 3. Anther: Tapetum (amoeboid and glandular); spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation. 4. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, monads, dyads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test germination: Calculation of percentage germination in different media using hanging drop method 5. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs). 6. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus. 7. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria. 8. Embryogenesis: Study of dicot embryo through permanent slides/photoghraphs; Study of embryos at various developmental stages through permanent slide/ photographs; Study of suspensor through electron micrographs. **Suggested Readings** **Anatomy** 1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.

	2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA. 3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA. 4. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Embryology 1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition. 2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co.Pvt.Ltd. Delhi. 3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands. 4. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands
DSC-7 **BOTDSC407T** **Morphology & Plant systematics** **50 Marks**	**Theory: 50 marks** **Lectures: 50** **Morphology** **Unit 1: inflorescence** – Types with examples, concept of advanced and primitive types. **Unit 2: Flower –** Types with examples, aestivation, floral parts (calyx, corolla, androecium, gynaecium)– various types of cohesion and adhesion with examples; carpel-types, advance and primitive ones and placentations (types)- Advanced and primitive. **Unit 3: Fruits and Seeds –**types with examples, Dipersal of seeds **Plant systematics** **Unit 1: Significance of Plant systematics**- Introduction to systematics; plant identification, classification, nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Functions of herbarium and botanical gardens; importance of herbaria and botanical gardens of the world and India; virtual herbarium; e-flora; documentation: flora, monographs and manuals, journals; keys: single access and multi-access. **Unit 2: Taxonomic hierarchy -**Concept of taxa (family, genus, species); categories and taxonomic hierarchy; species concept (taxonomic, biological, evolutionary). **Unit 3: Botanical nomenclature**-Principles and rules (ICN); ranks and names; typification, author citation, valid publication, rejection of names, principle of priority and its limitations; names of hybrids. **Unit 4: Systems of classification**- Major contributions of Theophrastus, Linnaeus, Hutchinson, Takhtajan and Cronquist; classification systems of Bentham and Hooker (up to series) and Engler and Prantl (up to series); brief reference of angiosperm phylogeny Group (APG III) classification.

DSC-7 **BOTDSC407P** **Morphology & Plant systematics** **(10+10)+30=50 marks**	**Unit 5: Biometrics, numerical taxonomy and cladistics-** Characters; Characterstates, variations; OTUs and OEUs, character weighing and coding; cluster analysis; phenograms,Cladograms (definitions and differences). **Unit 6: Phylogeny of Angiosperms-** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly and clades). Origin and evolution of Angiosperms (Brief Idea). **PRACTICAL** 1.Study of the vegetative and floral characters of the following families (fifteen species among them at least one from each family) description, VS of flower, section of ovary, floral diagram/s, floral formula and systematic position according to Bentham & Hooker's system of classification: Asteraceae (Compositae) - *Sonchus/Launaea*, *Vernonia/Ageratum*, *Eclipta/Tridax/Synedrella* Solanaceae - *Solanum spp./Withania/Physalis* Brassicaceae (Cruciferae) –*Nasturtium sp./ Brassica* Lamiaceae (Labiatae)- *Salvia/Ocimum/Leucus/Leonurus/Anisomeles/Hyptis* Euphorbiaceae - *Euphorbia spp., Jatropha/Acalypha/Croton* Malvaceae –*Sida spp./Urena/Malachra capitata/Hibiscus vitifolius* Polygonaceae – *Polygonum spp/Rumex* Acanthaceae –*Justicia/Rungia/Ecbolium/Hygrophila* Scrophulariaceae – *Lindenbergia/Mazus/Vandellia (Lindernia)*/ Rubiaceae – *Oldenlandia/ Dentella/ Spermacocce* **2. Botanical excursion** – at least three in number (with provision of fund from college) a. Visit to Botanic Garden (Acharya Jagadish Chandra Bose Indian Botanic Garden, BSI). b. Field visit (Local). c. At two different ecological zones. **Suggested Readings** **Morphology of Angiosperms** 1. Mitra, D., Guha, J. & Chowdhury, S.K....Studies in Botany, Vol.I [Moulik Library] 2. Eames, A.J. .....Morphology of Angiosperms [McGraw Hill] 3. Lawrence, G.H.M..... (Glossary in) Taxonomy of Vascular Plants [Oxford & IBH] **Plant systematics** 1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition. 2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge. 3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.

	4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi. 5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.

SEMESTER V **400 marks**	**Major - (DSC-8) BOTDSC508T+BOTDSC508P** **(DSC-9) BOTDSC509T+BOTDSC509P** **(DSC-10) BOTDSC5010T+BOTDSC5010P** **(DSC-11) BOTDSC5011T+ BOTDSC5011P**
DSC-8 **Course Code: BOTDSC508T** **Plant ecology& Phytogeography (40+20)=50 marks**	**THEORY: 50 marks** **Lectures: 50** **Plant Ecology 40 marks** **Unit 1: Introduction**: Basic concepts; Levels of organization. Homeostasis. **Unit 2:** Soil: Importance; origin; ; composition; physical; chemical and biological properties;soil profile; role of climate in soil development. **Unit 3:** Water: Importance; states of water in the environment; atmospheric moisture; hydrological cycle; water in soil; water table. **Unit 4:** Adaptations of plants to variations of light, temperature, wind and fire. **Unit 5:** Biotic interactions:Trophic organization, basic sources of energy and energy flow in ecosystem, symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop. **Unit 6:** Population ecology: Characteristics and Dynamics, r and k selection, Ecological Speciation. **Unit 7:** Plant communities and successions: Concept of ecological amplitude; habitat and niche; characters- analytical and synthetic; ecotone, **Unit 8:** Functional aspects of ecosystem: Energy sources and principles and models of energy flow; production and productivity; ecological efficiencies; biogeochemical cycles; cycling of carbon, nitrogen and phosphorus. **Phytogeography 10 marks** **(10 Lectures)** Principles; continental drift and theory of tolerance (brief account); endemism; brief description of major terrestrial biomes – Tropical rain forest, Temperate grassland and Tundra; Phytogeographical division of India (BSI 1996); Local Vegetation.
DSC-8 **BOTDSC508P** **Plant ecology& Phytogeography (10+10)+30=50 marks**	**PRACTICAL** **50 marks** 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter. 2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper).

	3. Analysis for carbonates, chlorides, nitrates, organic matter and base deficiency from two soil samples by rapid field tests. 4. Determination of organic carbon of different soil samples by Walkley & Black rapid titration method. 5. Determination of dissolved oxygen and carbon dioxide of water samples from polluted and unpolluted sources. 6. (a). Study of anatomical adaptations of hydrophytes and xerophytes – by preparation of temporary slides of *Nymphaea petiole, Hydrilla* stem, *Nerium or Casuarina leaf*. (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Epiphytes (*Vanda* root), Predation (Insectivorous plants) – from permanent slides and preserved specimens. 7. Determination of minimum size of quadrate for the study of herbaceous vegetation by species area curve method (species to be listed). 8. Quantitative analysis of herbaceous vegetation for frequency and comparison with Raunkiaer's frequency distribution law. 9. Quantitative analysis of herbaceous vegetation for density and abundance. 10. Field visit to familiarize students with ecology of different sites. **Suggested Readings** 1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition. 2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India. 3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition. 4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach.Oxford University Press. U.S.A. 5.Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition. 6. Misra R (1968) Ecology Workbook. Oxford and IBH Publ. Co., Calcutta 7.Ambasht and Ambasht (2012) A text book of Plant Ecology. CBS Publ. 8. Flora of India, Introductory Volume. I, Botanical Survey of India, 1996, Kolkata.
DSC-9 **BOTDSC509T** **Cell Biology & Genetics (25+25)=50 marks**	**THEORY: 50 marks** **Cell Biology 25 marks (50 Lectures)** **Unit 1: The cell -** Cell as a unit of structure and function; characteristics of prokaryotic and eukaryotic cells; origin of eukaryotic cell (Endosymbiotic theory). **Unit 2: Cell wall and plasma membrane -** Chemistry, structure and function of plant cell wall; overview of membrane function; fluid mosaic model; chemical composition of membranes; membrane transport – passive, active and facilitated transport, endocytosis and exocytosis.

	Unit 3: Nucleus: Structure - nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleosome concept, nucleolus (ultrastructure and development). Nucleic acids: Structure of nitrogenous bases; structure and function of nucleotides; types of nucleic acids; structure of A, B, Z types of DNA; types of RNA; structure of tRNA. **Cytoskeleton:** Role and structure of microtubules, microfilaments and intermediary filament. **Chloroplast, mitochondria and peroxisomes:** Structural organization; function; semiautonomous nature of mitochondria and chloroplast. **Endomembrane system:** Endoplasmic reticulum – structure, targeting and insertion of proteins in the ER, protein folding, processing; smooth ER and lipid synthesis, export of proteins and lipids; Golgi apparatus – organization, protein glycosylation, protein sorting and export from Golgi apparatus; lysosomes. **Unit 4: Cell division-** Phases of eukaryotic cell cycle, mitosis and meiosis; regulation of cell cycle - checkpoints, role of protein kinases. **Genetics 25 marks (50 Lectures)** **Unit 5: Mendelian genetics and its extension** Mendelism: Principles of inheritance; chromosome theory of inheritance; autosomes and sex chromosomes; probability and pedigree analysis; incomplete dominance and co dominance; multiple alleles, lethal alleles, epistasis, pleiotropy, recessive and dominant traits, penetrance and expressivity, numericals; polygenic inheritance. **Unit 6: Extrachromosomal Inheritance -** Chloroplast mutation: Variegation in Four o'clock plant; mitochondrial mutations in yeast; maternal effects-shell coiling in snail; infective heredity- kappa particles in Paramecium. **Unit 7: Linkage, crossing over and chromosome mapping -** Linkage and crossing over-cytological basis of crossing over; recombination frequency, two factor and three factor crosses; interference and coincidence; numericals based on gene mapping; sex Linkage. **Unit 8: Variation in chromosome number and structure** - Deletion, duplication, inversion, translocation, position effect, euploidy and aneuploidy **Unit 9: Gene mutations** Types of mutations; molecular basis of mutations; mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); detection of mutations: ClB method. Role of transposons in mutation; DNA repair mechanisms. **Unit 10: Fine structure of gene**- Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; structure of phage T4, rII locus. **Unit 11. Population and Evolutionary Genetics -** Allele frequencies, genotype frequencies, Law of probability, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and speciation.

DSC-9 **BOTDSC509P** **Cell Biology & Genetics** **(10+10)+30=50 marks**	**PRACTICAL 50 Marks** 1. Study of cell and its organelles with the help of electron micrographs. 2. Study of staining technique, pretreatment chemical, fixation, mordant and stain and their types. 3.a. Mitosis through temporary squash preparation (*Allium cepa*, *Lens esculentus*, *Aloe vera*). b. Meiosis through temporary smear preparation (*Allium cepa*, *Rhoeo discolor*). 5. Mendel's laws through seed ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1). Laboratory exercises in probability and chi-square. 6. Chromosome mapping using point test cross data. 7. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). 8. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes (demonstration through pictures). 9. Photographs and permanent slides showing translocation ring, Laggards and Inversion Bridge, Multipolarity, Sticky Bridge, Fragmentation and Pollen mitosis. 10. Study of human genetic traits: Sickle cell anemia, xeroderma pigmentosum, albinism, red-green colour blindness, widow's peak, rolling of tongue, Hitchhiker's thumb and attached ear lobe. (Demonstration through pictures). **Suggested Readings** 1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition. 2. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition. 3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco 5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition. 6. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition. 7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition. 8. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
DSC-10 **Plant Physiology** **BOTDSC6010T** **50 Marks**	**Theory:50** **Lectures: 50** **Plant Physiology-** **(50 Lectures)**

DSC-10 **BOTDSC6010P** **Plant Physiology** **(10+10)+30=50 marks**	**Unit 1: Plant-water relations-** Water potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory; transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement. **Unit 2: Mineral nutrition-** Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, **chelating agents.** **Unit 3: Nutrient Uptake -**Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport. **Unit 4: Translocation in the phloem-** Experimental evidence in support of phloem as the site of sugar translocation; pressure flow model; phloem loading and unloading; source- sink relationship. **Unit 5: Plant growth regulators-** Discovery, chemical nature (basic structure), bioassay and molecular aspects of the physiological roles of auxin, gibberellins, cytokinin, abscisic acid, ethylene. Brief account of Brassinosteroids and Jasmonic acid. **Unit 6: Physiology of flowering**- Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy and germination. **Unit 7:** Phytochrome, cryptochromes and phototropins- Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action. **PRACTICAL** **Plant Physiology** 1. Determination of osmotic potential of plant cell sap by plasmolytic method. 2. Determination of water potential of given tissue (potato tuber) by weight method. 3. Study of the effect of wind and light on the rate of transpiration in any leaf (*Basella*, *Hibiscus*) 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte (*Basella*), xerophytes (*Ficus*) and hydrophytes (*Eichornia*). 5. To determine the proportion of area covered by stomatal pore with respect to the total leaf area for mesophyte and xerophyte (both surfaces),hydrophytes. 6. To study the phenomenon of epigeal and hypogeal seed germination with respect to light. 7. To study the effect of different concentrations of IAA on *Avena* coleoptile elongation (IAA bioassay). 8. To study the induction of amylase activity in germinating wheat/barley grains **All experiments are to be performed in replicates and results to be expressed with standard error.**

	Demonstration experiments. 1. To demonstrate suction due to transpiration. 2. Fruit ripening/rooting from cuttings (demonstration). 3. Bolting experiment/Avena coleptile bioassay (demonstration). **Suggested Readings** **Biochemistry** 1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning 2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone 3. TymoczkoJL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman 4. Berg JM, TymoczkoJL and Stryer L (2011) Biochemistry, W.H.Freeman and Company 5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company. **Plant Physiology** 1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition. 2. Taiz, L., Zeiger, E., M Øller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition. 3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
DSC-11 **BOTDSC5011T** **Plant Breeding and Biostatistics (15+35)=50 marks**	**THEORY:50marks** **Plant Breeding 15 marks (15 Lectures)** **Unit1:** Introduction: - Aim and Objective of plant breeding. **Unit2:** Methods of plant breeding:- Methods of Hybridisation - Mass selection, Pureline selection; Bulk method and Pedigree method: Marker assisted selection (MARS) Male sterility and its use; 2 Back cross and Test cross; Heterosis; Mentainance of germplasm. **Biostatistics 35 marks (35 Lectures)** **Unit 1:** Definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistic **Unit 2:** Collection of data primary and secondary -Types and methods of data collection procedures - merits and demerits. Classification -tabulation and presentation of data - sampling methods. **Unit 3:** Measures of central tendency - Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co-efficient of variations, concept of 'p' value and its limitations.

DSC-11 **BOTDSC5011P** **Plant Breeding and Biostatistics** **(10+10)+30=50 marks**	**Unit 4:** Correlation -Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression. **Unit5:** Statistical inference -Hypothesis - simple hypothesis - student 't' test - chi square test. Calculation of F-value **PRACTICAL** 1) Calculation of mean, standard deviation and standard error. 2) Calculation of correlation coefficient values and finding out the probability. 3) Calculation of 'F' value 4) Calculation of student's T –test **Suggested Readings** **Plant Breeding** 1. Chawdhuri, H.K .Elementary Principles of Plant Breeding [Oxford & IBH] 2. Allard, R.W. Principles of Plant Breeding [John Wiley] 3. Poehlman, J.M. & Barthakur, D. Plant Breeding [Oxford & IBH] 4. Singh, B.D. Plant Breeding: Principles and Methods [Kalyani Publishers] **Biostatistics** 1. Biostatistics, Danniel, W.W., 1987.New York, John Wiley Sons. 2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore 3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press. 4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin. 4. The Principles of scientific research, Freedman, P. New York, Pergamon Press. 5. Statistics for Biologists, Campbell, R.C., 1998.Cambridge University Press.

SEMESTER VI **T+P** **400 marks**	**Major –(DSC-12) BOTDSC6012T+BOTDSC6012P** **(DSC-13) BOTDSC6013T+BOTDSC6013P** **(DSC-14) BOTDSC6014T+BOTDSC6014P** **(DSC-15) BOTDSC6015T+BOTDSC6015P**
DSC-12 **BOTDSC5012T** **Molecular Biology** **50 marks**	**THEORY: 50 marks** **Lectures: 50** **Molecular Biology** **Unit 1: Nucleic acids:** Carriers of genetic information, DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment). Unit 2. Genetic Material- Types of genetic material, denaturation and renaturation, cot curves; organization of DNA- prokaryotes, viruses, eukaryotes. mitochondrial DNA and chloroplast DNA, Chromatin structure with special reference to euchromatin and heterochromatin-constitutive and facultative heterochromatin. **Unit 3: The replication DNA both Prokaryotic and Eukaryotic** - Chemistry of DNA synthesis (Kornberg's discovery); general principles – bidirectional, semi conservative and semi discontinuous replication, RNA priming; various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication. **Unit 4: Central dogma and genetic code**-Key experiments establishing-the central dogma (adaptor hypothesis and discovery of mRNA template), Genetic code: salient features and deciphering (triplete binding assay). **Unit 5: Transcription**-Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation (Operon concept), inducible and repressible operon. Prokaryotes: regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing. **Unit 6: Processing and modification of RNA**-Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' polyA tail); Ribozymes; RNA editing and mRNA transport. **Unit 7: Translation** - Ribosome structure and assembly, mRNA; charging of tRNA, aminoacyl tRNA synthetases; various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; fidelity of translation; inhibitors of protein synthesis; post-translational modifications of proteins.
DSC-12 **BOTDSC6012P** **Molecular Biology** **(10+10)+30=50**	**PRACTICAL** 1. DNA isolation from cauliflower head/ Onion leaf and Agarose gel electrophoresis.

	2. DNA estimation by Diphenylamine reagent/UV Spectrophotometry. 3. RNA estimation by Orcinol method. 4. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 5. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs**.** 6. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments) 7. Study of the following through photographs: assembly of Spliceosome machinery; splicing mechanism in group I & group II introns; ribozyme and alternative splicing. **Suggested Readings** 1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition. 2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition. 4. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3 rd edition. 5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition
DSC-13 **BOTDSC6013T** **Plant Biochemistry & Metabolism** **50 marks**	**Theory: 50 marks** **Lectures:50** **Unit 1: Concept of metabolism-** Introduction, anabolic and catabolic pathways, regulation of metabolism, Types and significance of chemical bonds; structure and properties of water; pH and buffers. Enzymes - Structure of enzyme, holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; classification of enzymes; features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis–Menten equation enzyme inhibition-types, Lineweaver-Burk Plot, factors affecting enzyme activity. **Unit 2:** Bioenergenetics-Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP structure, its role as a energy currency molecule **Unit 3:** Carbohydrates: Nomenclature, structures and classification; monosaccharides disaccharides; oligosaccharides polysaccharides and sugar derivatives, isomerism **Carbon assimilation-**Photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO2 reduction, photorespiration,C_2 , C_4 pathways; Crassulacean acid metabolism; factors affecting CO_2 reduction.

	Unit 4: Carbohydrate metabolism -Synthesis and catabolism of sucrose and starch. **Unit 5: Carbon Oxidation- G**lycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration. **Unit 6: ATP-Synthesis -** Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase; role of uncouplers. **Unit 6: Lipids:** Definition and major classes of storage and structural lipids; fatty acids structure and functions; essential fatty acids; triacylglycerols structure, functions and properties; phosphoglycerides**.** **Lipid metabolism** -Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation. **Unit 7:** Proteins: Structure of amino acids; levels of protein structure-primary, secondary, tertiary and quarternary; protein denaturation and biological roles of proteins. **Nitrogen metabolism**-Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; ammonia assimilation and transamination. **Unit 8: Mechanisms of signal transduction -** Receptor-ligand interactions; G protein; second messenger concept, calcium calmodulin, MAP kinase cascade.
DSC-13 **BOTDSC6013P** **(10+10)+30=50 marks**	**PRACTICAL** **1.** Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins 1. Chemical separation of photosynthetic pigments. 2.Demonstration of absorption spectrum of photosynthetic pigments (spectrophotometer). 3. To study the effect of light intensity on the rate of photosynthesis. 4. Effect of carbon dioxide on the rate of photosynthesis (volume measurement) 5. To compare the rate of respiration in different parts of a plant. 6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources. 7. To study the activity of lipases in germinating oilseeds. **All experiments are to be done in replicates and results to be expressed with standard error** **Suggested Readings** 1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.

	2. Taiz, L., Zeiger, E., M Øller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition. 3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
DSC-14 **BOTDSC6014T** **Biotechnology &** **Plant Tissue Culture** **(35+15)=50 marks**	**Theory: 50 marks** **Biotechnology 35 marks (35 Lectures)** **Unit 1: Recombinant DNA technology-** Restriction Endonucleases (Types I-IV, biological role and application); Restriction mapping (linear and circular); cloning vectors: prokaryotic (pBR322, Ti plasmid, BAC); lambda phage, cosmid; eukaryotic vectors (YAC). **Unit 2: Gene Cloning-** Recombinant DNA, bacterial transformation and selection of recombinant clones, PCR-mediated gene cloning; gene construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR. **Unit 3: Methods of gene transfer-** Agrobacterium-mediated direct gene transfer by electroporation, microinjection,Microprojectile bombardment; selection of transgenics– selectable marker and reporter genes (luciferase, GUS, GFP). **Unit 4: Applications of Biotechnology-** Pest resistant (Bt-cotton); herbicide resistant plants (round up ready soybean); transgenic crops with improved quality traits (Golden rice); improved horticultural varieties (Moondust carnations); role of transgenics in bioremediation (Superbug); edible vaccines; industrial enzymes (aspergillase, protease, lipase); genetically engineered products–human growth hormone; humulin; biosafety concerns. **Plant Tissue Culture- 15 marks (15 Lectures)** Historical perspective; composition of media; nutrient and hormone requirements (role of vitamins and hormones); totipotency; organogenesis; embryogenesis (somatic and zygotic); protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; cryopreservation; germplasm conservation), hardening of the tissue culture raised plants for field plantation.
DSC-14 **BOTDSC6014P** **Biotechnology & Plant Tissue Culture** **(10+10) + 30=50**	**PRACTICAL** 1. (a) Preparation of MS medium. (b) Process of in vitro sterilization and inoculation methods by using different explants (leaf, nodal bud and seeds of tobacco, Datura, Brassica) 2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.

	3. Construction of restriction map of circular and linear DNA from the data provided. 4. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 5. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs. 6. Isolation of genomic DNA and its gel electrophoresis. **Suggested Readings** 1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands. 2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington. 3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5 th edition. 4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition. 5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
DSC-15 **BOTDSC6015T** **Analytical techniques** **50 marks**	**Theory: 50 marks** **Lectures: 50** **Unit 1:** Imaging and related techniques- Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching. **Unit 2: Cell fractionation- Centrifugation:** Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes. **Unit 3: Radioisotopes -**Use in biological research, auto-radiography, pulse chase experiment. **Unit 4: Spectrophotometry-** Principle and its application in biological research **Unit 5: Chromatography**- Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography. **Unit 6: Characterization of proteins and nucleic acids** - Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

BOTDSC6015P **Analytical technique** **(10+10)+30=50 marks**	**PRACTICAL** 1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs. 2. To separate amino acids by paper chromatography. 3. To separate sugars by thin layer chromatography. 4. To estimate protein concentration through Lowry's methods/ Bradford methods 5. To separate proteins using PAGE. 6. To separate DNA (marker) using AGE. 7.Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH). **Suggested Readings** 1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition. 2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A. 3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.

MINOR PAPERS

SEMESTER I **T+P** **50+50=100 marks**	**Minor 1, MA I**
Course Code: **BOTMIN101T/** **BOTCOR101T** **FM-50** **Phycology** **Microbiology** **Mycology** **Phytopathology** **Archegoniate**	**Biodiversity (Microbes, Algae, Fungi and Archegoniate)** **Theory- 50 Marks (30 Lectures)** **Unit 1: Microbes** Viruses – discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); economic importance; bacteria – discovery, general characteristics and cell structure; reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); economic importance. **Unit 2: Algae** General characteristics; ecology and distribution; range of thallus organization and reproduction; classification of algae (Lee 2018); morphology and life-cycles of *Nostoc*, *Oedogonium*, *Fucus*, *Polysiphonia*. Economic importance of algae. **Unit 3: Fungi and Phytopathology** Introduction - General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification (Hawksworth et al1995); true Fungi- general characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); symbiotic associations – Lichens - general account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance **Phytopathology**:Terms & Definitions - Pathogen, Propagule, Vector, Inoculum, Infection, Symptoms (necrosis, wilt, spot, blight, hypoplastic & hyperplastic).// Disease & Disease Cycle, Disease Triangle, Disease Management // Koch's postulates // Phytoalexins.// Symptoms, Causal organisms, Disease cycle & Control measures of - (a) Tungro virus disease of rice & (b) Late blight of potato. **Unit 4: Introduction to Archegoniate** Unifying features of archegoniates, transition to land habit, alternation of generations. **Unit 5: Bryophytes** General characteristics, adaptations to land habit, classification (Proskauer 1954, up to class), range of thallus organization. Systematic position, morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria*

Course Code: BOTMIN101P/ BOTCOR101P FM-50 (10+10)+30 Phycology Microbiology Mycology Phytopathology Archegoniate	(developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*. **Unit 6: Pteridophytes** General characteristics, classification (Sporne 1975), early land plants (*Cooksonia* and *Rhynia*). Systematic position, morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris* (developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economic importance of Pteridophytes. **Unit 7: Gymnosperms** General characteristics, classification (Sporne), systematic position, morphology, anatomy and reproduction of *Cycas* and *Pinus*. (developmental details not to be included). Ecological and economic importance. **Practical 50 Marks** **1.** Gram staining of bacteria from curd sample. **2.** Study of vegetative and reproductive structures of *Nostoc* (electronmicrographs), *Oedogonium* (Preparation of temporary slides), *Fucus* and *Polysiphonia* through permanent slides. **3.** *Rhizopus* and *Penicillium* - Asexual stage from temporary mounts and sexual structures through permanent slides. **4.** *Puccinia* - herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves (permanent slides) of both the hosts. **5.** *Agaricus* - specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus*. **6.** Lichens - study of growth forms of lichens (crustose, foliose and fruticose). **7.** Mycorrhiza - ectomycorrhiza and endomycorrhiza (Photographs). **8.** *Marchantia* - morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae, v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides). **9.** *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores, permanent slides showing antheridial and archegonial heads, l.s. capsule. **10.** *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll, l.s. strobilus (permanent slide). **11.** *Equisetum* - morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m.spores (wet and dry). **12.** *Pteris* - morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores, **13.** *Cycas* - morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores, l.s. ovule, t.s. root (permanent slide). **14.** *Pinus* - morphology of long and dwarf shoots, male and female cone, t.s. needle, stem, w.m. microsporophyll, w.m. microspores, l.s. female cone, female cone (permanent slide).

SEMESTER II **T+P** **50+50=100**	**Minor 2, MA II**
Course Code: **BOT MIN202T/ BOTCOR202T** **FM-50** **Plant Ecology and Taxonomy**	**Plant Ecology and Taxonomy** **Theory – 50 Marks** **(50 Lectures)** **Unit 1:** Introduction **Unit 2:** Ecological factors – Soil - Origin, composition, soil profile; water- states of water in the environment; Light and temperature - variation optimal and limiting factors; Adaptation of hydrophytes and xerophytes. **Unit 3:** Plant communities - characters; Ecotone and edge effect; succession; processes and types. **Unit 4:** Ecosystem - structure; energy flow trophic organisation; food chains and food webs, Ecological pyramids; production and productivity; biogeochemical cycling; cycling of carbon, nitrogen. **Unit 5:** Phytogeography- principle biogeographical zones; Endemism. **Unit 6:** Introduction to plant taxonomy- identification, classification, nomenclature. **Unit 7:** Identification - functions of herbarium, important herbaria and botanical gardens of the world and India; **Unit 8:** Taxonomic hierarchy - ranks, categories and taxonomic groups. **Unit 9:** Botanical nomenclature - principles and rules (ICN); ranks and names; binominal system, typification, author citation, effective and valid publication. **Unit 10:** Classification - types of classification - artificial, natural and phylogenetic. Classification of Bentham and Hooker (up to series), general idea of Cronquist's classification (1981). **Unit 11:** Numerical taxonomy and cladistics (4 Lectures) – characters, variations, cluster analysis, phenograms, cladograms (definitions and differences).
Course Code: **BOTMIN202P/ BOTCOR202P** **FM-50** **=20+30** **Plant Ecology and Taxonomy**	**Practical = 50 Marks** **1.** Study of instruments used to measure microclimatic variables - Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter. **2.** Determination of pH and analysis of two soil samples for carbonates, chlorides, nitrates, organic matter and by rapid field test.

	3.(a) Study of morphological adaptations of hydrophytes (*Nymphaea* petiole) and xerophytes (*Nerium* leaf) (four each). **3(b)** Study of biotic interactions of Stem parasite (*Cuscuta*), Epiphytes (Orchid root). **4.** Determination of minimal quadrat size for the study of herbaceous vegetation in the HEI campus/ suitable site by species area curve method. (Species to be listed). **5.** Quantitative analysis of herbaceous vegetation in the HEI campus /suitable site for frequency and comparison with Raunkiaer's frequency distribution law. **6.** Study of vegetative and floral characters of the following families (Description, V.S. of flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham and Hooker's system of classification): Brassicaceae – *Nastertium indicum*; Asteraceae – *Eclipta* and *Tridax*; Solanaceae – *Nicotiana plumbaginifolia*, *Solanum nigrum*, Lamiaceae - *Leonurus sibiricus*, *Leucas aspera* and *Ocimum sanctum*; Liliaceae - *Allium*. **7.** One Local Excurssion and Mounting of a properly dried and pressed specimen of any ten wild plant with herbarium label (to be submitted with the record book).

SEMESTER III **T+P** **50+50=100**	**Minor 3, MA III**
BOT MIN303T/ BOTCOR303T Plant Anatomy and Embryology **FM 50**	**THEORY: 50marks** **(Lectures 50)** ***Unit 1: Meristematic and permanent tissues***- Root and shoot apical meristems; Simple and complex tissues. **Unit 2: Organs**- Structure of dicot and monocot root stem and leaf. **Unit 3: Secondary Growth** -Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). **Unit 4: Adaptive and protective systems**-Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes. **Unit 5: Structural organization of flower**- Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. **Unit 6: Pollination and fertilization**-Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. **Unit 7: Embryo and endosperm** -Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship. **Unit 8: Apomixis and polyembryony**-Definition, types and practical applications.
BOT MIN303P/ BOTCOR303P Plant Anatomy and Embryology **(10+10)+30=50**	**PRACTICAL** **Marks 50** 1. Study of meristems through permanent slides and photographs. 2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)

	3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides). 4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides). 5. Leaf: Dicot and Monocot leaf (only Permanent slides). 6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Nymphaea petiole). 7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). 8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/campylotropous from permanent slides. 9. Ultrastructure of mature egg apparatus cells through electron micrographs. 10. Pollination types and seed dispersal mechanisms (including appendages**,** aril,caruncle)(Photographs and specimens)**.** 11. Dissection of embryo/endosperm from developing seeds. 12. Calculation of percentage of germinated pollen in a given medium. **Suggested Readings** 1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition. 2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

SEMESTER IV **BOTCOR404** **T + P =50+50=100**	**Minor 4, MA IV**

BOTCOR404T **Plant Physiology and Metabolism** **50 marks**	**Theory: 50 marks** **Lectures:50** **Unit 1: Plant-water relations-**Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation**.** **U nit 2:** Mineral nutrition-Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential, elements; Transport of ions across cell membrane, active and passive transport,carriers, channels and pumps. **Unit 3: Translocation in phloem-** Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading andunloading**.** **Unit 4: Photosynthesis -** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reactioncenter,antenna molecules;Electron transport and mechanism of ATP synthesis; C 3 , C4 andCAM pathways of carbon fixation; Photorespiration. **Unit 5: Respiration-** Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway. **Unit 6: Enzymes** - Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition. **Unit 7: Nitrogen metabolism-** Biological nitrogen fixation; Nitrate and ammonia assimilation. **Unit 8: Plant growth regulators-**Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. **Unit 9: Plant response to light and temperature-**Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization **PRACTICAL 50 Marks**
BOTCOR404P **Plant Physiology and Metabolism** **5+20+25=50 marks**	1. Determination of osmotic potential of plant cell sap by weighing method. 2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig (*Basella/ Hibiscus*). 3. Calculation of stomatal index and stomatal frequency of a mesophyte (*Basella)* 4. Demonstrate the activity of urease and study the effect of pH and enzyme concentration. 5.To study the effect of bicarbonate concentration on O2 evolution inphotosynthesis. 6. Comparison of the rate of respiration in any two parts of a plant. **Demonstration experiments** 1. Effect of auxins on rooting. 2. Suction due to transpiration. 3. R.Q. 4. Demonstration of plasmolysis

	Suggested Readings 1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5 th Edition. 2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4 th Edition. 3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

SEMESTER V **T+P** **50+50=100**	**Minor 5, MA V**
BOTCOR505T **Cell and Molecular Biology** **50 marks**	**THEORY: 50 marks** **(Lectures 50)** **Unit 1: Techniques in Biology** - Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis. **Unit 2: Cell as a unit of Life**- The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. **Unit 3: Cell Organelles** - Mitochondria:Structure, marker enzymes, composition; Semiautonomous nature;Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplastDNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis. Nucleus: Nuclear Envelope-structure of nuclear pore complex; chromatin; molecularorganization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

	Unit 4: Cell Membrane and Cell Wall- The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of themembranes; Selective permeability of the membranes; Cell wall. **Unit 5: Cell Cycle-** Overview of Cell cycle, Mitosis and Meiosis; Molecular controls. **Unit 6: Genetic material-**DNA: Miescher to Watson and Crick-historic perspective, Griffith's and Avery' stransformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ø (theta) mode of replication, replication of linear, ds-DNA, replicating the 5´ end of linear chromosome including replication enzymes. **Unit 7: Transcription (Prokaryotes and Eukaryotes)**- Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types;Translation (Prokaryotes and eukaryotes), genetic code. **Unit 8: Regulation of gene expression-** Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.
BOTCOR505P Cell and Molecular Biology 5+20+25=50	**PRACTICAL Marks 50** 1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light andelectron micrographs. 2. Study of the photomicrographs of cell organelles. 3. To study the structure of plant cell through temporary mounts. 4. Study of mitosis and meiosis (temporary mounts and permanent slides). 5. Study of plasmolysis and deplasmolysis on Rhoeo leaf. 6. Measure the cell size (either length or breadth/diameter) by micrometry. 7. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs. 8. Study DNA packaging by micrographs. 9. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome**.** **Suggested Readings** 1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. 3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

	4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
SEMESTER VI **BOTCOR606** **T + P** **50+50=100**	**Minor 6, MA VI**
BOTCOR606T **Analytical Techniques in Plant Sciences** **50 marks**	**Theory: 50 marks** **Lectures:50** **Unit 1: Imaging and related techniques -** Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching. **Unit 2: Cell fractionation-** Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes. **Unit 3: Radioisotopes -** Use in biological research, auto-radiography, pulse-chase experiment. **Unit 4: Spectrophotometry-**Principle and its application in biological research. **Unit 5: Chromatography-**Principle;Paperchromatography;Column chromatography, TLC, GLC, HPLC, Ion exchange chromatography; Molecular sieve chromatography; Affinity chromatography. **Unit 6: Characterization of proteins and nucleic acids -** Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE **Unit 7: Biostatistics-** Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.
BOTCOR606P	**PRACTICALS**

Analytical Techniques in Plant Sciences **5+20+25=50**	1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs. 2. To separate nitrogenous bases by paper chromatography. 3. Isolation of chloroplasts by differential centrifugation. 4. To estimate protein concentration through Lowry's methods. 5. To separate proteins using PAGE. 6. To separate DNA (marker) using AGE. 7.Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH). 8. Demonstration of permanent slides (double staining) (any slide). **Suggested Readings** 1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition. 2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A. 3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd Edition. 4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4 th edition.

SEC (SKILL ENHANCEMENT COURSE)

Odd Semesters

SEC I FROM BOTANY

Credit 3, FM 50 (Classes 30+ Project)

Course Code: BOTHSEC101M

FLORICULTURE AND GARDENING

Objectives:

The course aims to make students understand the theoretical and practical details of nursery and gardening. Knowledge so gained will provide them with the means for their employment and also of others.

Learning outcomes:

The students will be able to distinguish and choose the plant species amenable for nursery and gardening. They can develop their own nursery for livelihood and marketing purposes. The course will also equip the students with the basic skill needed to design and lay gardens.

Syllabus—3 Credit (Classes 30+ Project)

Unit-1. Introduction to Nursery and Gardening

Unit-2. Definition and types of nurseries; Physical resources for nurseries; selection of nursery site, ecological conditions, important nursery operations.

Unit-3. Definition and components of gardens; Types of gardening (landscape and home gardening). Scope and objective of gardening; garden landscaping with specific reference to Kew Botanical garden, AJC Bose Indian Botanic Garden, Kolkata

Unit-5 Plant Propagation Methods- Seed dormancy – causes and methods of breaking it; seed germination, types and factors affecting it. Vegetative propagation; artificial and natural methods; Concept of soilless cultivation with special reference to sand culture and hydroponics.

Unit- 6: Training/ Workshop/ Field visit, establishment of nursery

OR

Course Code: BOTHSEC101M

MUSHROOM CULTIVATION TECHNIQUE

Objectives:

The course aims to make students understand the theoretical and practical details of mushroom cultivation technique. Knowledge so gained will provide them with the means for self-employment and also employment of others.

Learning outcomes:

The students will be able to distinguish edible and nonedible mushrooms and can choose the fast grown as well as nutritious mushrooms. They can develop their own nursery for livelihood and marketing purposes. The course will also equip the students with the basic skill needed to design and lay mushroom house.

Unit -1. Introduction to mushrooms

Unit -2. Mushrooms -Taxonomical rank -History and Scope of mushroom cultivation - Edible and Poisonous Mushrooms-Vegetative characters

Unit -3: Common edible mushrooms-Button mushroom (*Agaricus bisporus*), Milky mushroom (*Calocybe indica*), Oyster mushroom (*Pleurotus sajorcaju*) and paddy straw mushroom (*Volvariella volvcea*).

Unit -4: Principles of mushroom cultivation- Structure and construction of mushroom house and sterilization of substrates. Spawn production culture media preparation-production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation, spawning, spawn running, harvesting, oyster and paddy straw mushroom cultivation. Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies.

Unit-5: Health benefits of mushrooms-Nutritional and medicinal values of mushrooms. Therapeutic aspects- antitumor effects.

Unit -6: Post harvest technology -Preservation of mushrooms - freezing, dry freezing, drying, canning, quality assurance and entrepreneurship .Value added products of mushrooms.

Unit-7: Training/ Workshop/ Field visit Sterilization and sanitation of mushroom house, instruments and substrates Preparation of mother culture, media preparation, inoculation, incubation and spawn production Cultivation of oyster mushroom using paddy straw/agricultural wastes

Even Semesters

SEC II FROM BOTANY

Credit 3 FM 50 (Classes 30+ Project)

Course Code: BOTHSEC202M

TECHNIQUES OF VERMICOMPOSTING

Objectives:

The course aims to make students understand the theoretical and practical details of nursery and gardening. Knowledge so gained will provide them with the means for their employment and also of others.

Learning outcomes:

The students will be able to distinguish and choose the earthworm species for vermicomposting. They can develop their own nursery for livelihood and marketing purposes. The course will also equip the students with the basic skills needed to design vermicomposting beds.

Unit-1. Introduction to Vermiculture. Definition, meaning, history, economic importance, and value in maintenance of soil structure. Choosing the right worm. Useful species of earthworms, local species

Unit-2. Vermicomposting materials and their classification. Feeding habits and food for composting worms.

Unit-3. Vermicomposting methods such as –Small-scale and large-scale pit methods; heap methods, window method, etc. Factors affecting vermicomposting such as pH, moisture, temperature.

Unit-4. Vermicomposting: general procedure in homes; Maintenance of vermicomposting beds. Harvesting the worms, Earthworm Predators, Parasites, and pathogens.

Unit-5. Application of vermicomposting in Agriculture and Horticulture practices. Advantages of vermicomposting.

Unit-6. Training/ Workshop/ Field visit/ establishment of vermicomposting unit.

OR

Course Code: BOTHSEC202M

TISSUE CULTURE TECHNIQUE AND MICROPROPAGATION

Objectives:

The objective of the course is to provide basic and applied training in the subject for development of skills for a successful career in entrepreneurship, generate technically trained human resource for tissue culture industries and as instructors in schools and junior colleges.

Learning outcomes Entrepreneurs who wish to establish their own labs will be benefitted with the lab to land training; researchers in plant tissue culture who have a focus on commercial applications such as crop improvement, secondary metabolite production, and various strategies for inducing genetic interference; persons who want to understand basic laboratory setup, handling of explant tissue, nutrient medium and establishing the culture, and incubation of cultures.

Unit-1. Introduction to plant tissue culture: Definition, brief history, principle and significance of tissue culture; cellular totipotency – cytodifferentation: factors affecting vasculartissue differentiation, cell cycle and TE differentiation; organogenic differentation: induction, factors affecting shoot bud differentiation

Unit- 2. Laboratory organization and Instrumentation: Design and layout for wash area, media preparation, sterilization and storage room, transfer area for aseptic manipulations, culture rooms, and observation/data collection areas. labwares, good laboratory practices, good safety. Working principle, maintenance and management of following instruments: Laminar air flow, autoclave, distillation unit, pH meter, orbital shaker, microscope, deep freezer, growth chamber Sterilization: Importance,

Unit-3. Tissue culture media: Introduction, Types of Media and its importance; Preparation of stocks, pH and Buffers and their significance in media. Media Constituents (Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, hormones, Activate charcoal).

Unit-4. Plant hormones: Role of Plant hormones (auxins, cytokinins, abscissic acid, ethyleneand Gibberellins) in plant development.

Unit-5. Aseptic techniques: Methods of sterilization of equipments, culture media and explants:-Washing and preparation of glassware's, packing and sterilization, media sterilization,surface sterilization, aseptic workstation, precautions to maintain aseptic conditions.

Unit-6. Micropropagation: Meristem culture for the production of virus free plants. Nucellus culture for clonal propagation and large scale multiplication, strategies of micropropagation. Stages of micropropagation via axillary shoot proliferation in monocots and dicots and methods of micropropagation through organogenesis. Micropropagation - direct and indirect somatic embryogenesis. Low cost methods for micropropagation.

MULTIDISCIPLINARY COURSES (MDC) FROM BOTANY

SEMESTER I (MDC-1)

Credit -3 FM- 50, (Classes 30+ Project)
Subject Code: BOTGMD101T

PLANTS–IMPORTANCE AND PROPAGATION IN ETHNOBOTANICAL ASPECT

Objective:
The course has been framed to familiarize students with the importance of plants for the sustenance of our planet in general and mankind in particular. It also aims to educate them about different modes of plant reproduction.
Learning outcomes:
The course will teach the students the importance of plants and the diversity of their methods of propagation. Insights gained therein will help them to bring the economic taxa of ethnobotanical importance under effective cultivation.

Unit-1 Importance of Plants: Plants and their role in climate stability -(soil fertility, prevention of soil erosion, availability of Oxygen, Carbon sequestration, pollution control).
1.1 Plants as source of food- (Wheat, Maize, Rice, Mango, Jamun, Rajmah, Apple, Bottlegourd and Fenugreek) – general description, botanical names and parts used.
1.2 Plants as source of fodder- (Clover, Oak, Bhimal) and timber (Pine, Deodar, Shisham and Teak) – general description, botanical names and parts used.
1.3 Plants as source of medicine- (Quinine, Belladona, Sarpgandha and Foxglove), essential oils (Lemon-grass and Lavender) and beverages (Tea and Coffee) – general description, botanical names and parts used.

Unit- 2 Modes of Vegetative Propagation: General account of asexual means of reproduction; Concept of apomixis and its main types; Natural and artificial means of vegetative propagation; advantages and limitations. Propagation by bulbs, corms, tubers, rhizomes, runners, stolons and suckers – general account, propagation by cutting, layering, grafting and budding – basic concepts.

Unit-3 Modes of Sexual Reproduction: General account of sexual means of

reproduction.2. Structure of flower and its various forms; types of pollination (self-versus cross) mechanisms. Fertilization, basic concept of seed and fruit development; seed germination.

Unit-4 Introduction to Ethnobotany: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; major and minor ethnic groups or tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit -5 Traditional Herbal Medicine: Indigenous systems of medicine; international plant drugs, their export and import; important controversial medicinal plants and their substitutes; endangered and rare plants of India; role of plant drugs in pharmaceutical industry. Strategies of conservation of medicinal, spices and other useful plants. Role of ethnobotany in sustainable development.

SEMESTER II

MULTIDISCIPLINARY COURSE (MDC-2)
Credit -3 FM-50, (Classes 30+ Project)
Subject Code: BOTGMD202T

BIOTECHNOLOGICAL APPLICATIONS IN AGRICULTURE

Objectives

To provide a knowledge base about biotechnology and its applications in agriculture, and use that understanding to ask questions and evaluate concerns relevant to current and future uses in plant and animal agriculture.

Learning outcomes:

Understand the scientific basis for genetic engineering and applications in agriculture. Become familiar with various applications of genetic engineering in agriculture – their purposes, uses and examine the impacts on environmental, health, social and ethical concerns and controversies associated with the use of genetically engineered products in agriculture. Critically evaluate information and logic underlying opposing points of view.

Unit-1 Introduction to biotechnology, Definition, Classical vs Modern biotechnology, Biosafety and ethical concerns

Unit-2 Conventional methods of crop improvement: Principles of plant breeding, Limitations of conventional breeding.

Unit-3 Crop biotechnology applications - Genetic engineering / rDNA technology Tissue culture, Embryo rescue, Somatic hybridization, Molecular-gene markers, Molecular diagnostics, Vaccine. Plant tissue culture in crop biotechnology: Definition, Basic techniques of plant tissue culture; micropropagatoin, haploid plant production, secondary metabolite production, germplasm conservation, virus elimination.

Unit-4 Genetic engineering in plants: Basic tools and methods of gene transfer, Agrobacterium-mediated and direct gene delivery methods. Development of Transgenic plants with insect resistance (BT varieties), high nutritional value (Golden rice), high quality protein (maize), pharamaceutical properties (edible vaccines)

Unit-5 Animal agriculture, animal biotechnology; animal cloning and transgenic animals; applications of biotechnology for animal agriculture; animal welfare/animal rights

Unit-6 Impact of biotechnology on developing countries; biotechnology and globalization of agriculture. GE crops; germplasm diversity, preservation, ownership; Intellectual property rights and patenting.

WEST BENGAL STATE UNIVERSITY

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Phone : (033) 2524 1975 / 1976 / 1978 / 1979 Fax: (033) 2524 1977

लक्ष्यं विश्वमानम्

Ref. WBSU/COE/NEP ADVISORY/2171/2024-25 Date 16/08/2024

CLARIFICATION ON DRAFT ADVISORY

FOR ADMISSION & EVALUATION IN 4-year Undergraduate Programme and 3-year Undergraduate Program Under Curriculum and Credit Framework for Undergraduate Programs Based on National Education Policy, 2020

For kind attention of :

(a) **All the Principals/TIC's/OIC's of the Colleges Affiliated to West Bengal State University.**
(b) **The Chairpersons/Coordinators, UG-BoS of all the Academic Departments of West Bengal State University.**

Respected Madam/Sir,

With reference to the above, you all are requested sincerely to take note of the following for kind perusal and implementation, wherever applicable.

- **SECs for 4-Year Undergraduate Programme & 3-Year Multidisciplinary Programme: With effect from academic session 2024-25**, students of the 4-Year programme will take 2 SECs from the Major subject in the first and the second semesters, and a third SEC from either of the Minor subjects as per his/her choice. Students taking admission in the 3-Year programme will take 2 SECs from one subject in 3rd & 4th semesters and another 2 SECs from another subject in the 5th and 6th semesters. **SEC 1 is to be offered in the odd semesters and SEC 2 in the even semesters. There should not any violation of this rule to facilitate the process of registration.**
- **Internship:** The Affiliated Colleges will have every discretion to organize internship as per their convenience without violating the stipulations laid down in the Regulations regarding course duration, credits and evaluation process. Further changes, if any, regarding the Internship under NEP 2020 curriculum, will be notified as corrigendum to the colleges after a workshop slated to be held in the third week of August' 2024.
- SEC or MDC courses shall have to be selected **only** from those offered by the **University**.
- **For the Academic Session 2023-24**, the Registration Portal would be reopened to enable students to opt for MDCs 2 & 3 for 4-year Undergraduate Programme **and** MDCs 5 & 6 for 3-Year Undergraduate Programme, without incurring any financial burden on them. The Registration Portal will remain active for Six (06) days, once opened. This time span is being provided for both filling of MDC subject choice by the students and complete verification of the same at the College end. The affiliated Colleges are thus requested to complete necessary preparatory work in order to fulfill the criteria within stipulated Six (06) days time including informing students under their jurisdiction. Verification of input filled by the students shall be the sole responsibility of the college concerned.
- **From the Academic Session 2024-25**, the Registration Portal should reflect the 3 MDC options for the first 3 Semesters.
- MDC in Library Science and Digitization can be offered as per the syllabus provided by the University and decisions taken by the concerned UG-BoS.
- **With Effect From the Academic Section 2024-25** : '3 Year Multidisciplinary UG Course' would be renamed as **'3 Year Multidisciplinary UG Programme' (MDP)** to avoid confusion with the MDCs.

16/08/2024.

In Charge of the Office of the Controller of Examinations
West Bengal State University

Copy of this letter forwarded for information and necessary action, if any, to:

1. Vice-Chancellor's Secretariat, W.B.S.U
2. All the Chairpersons/Coordinators UGBOS, W.B.S.U.
3. The Registrar (Officiating), W.B.S.U- with a request to kindly arrange to upload this Notice in the University website.
4. The Inspector of Colleges(Officiating), W.B.S.U
5. Registration Section, W.B.S.U
6. Ms. Sharmili Majumder. e-mail: majumder.sharmili10@gmail.com
7. Guard File. W.B.S.U.

16/08/2024.

In Charge of the Office of the Controller of Examinations
West Bengal State University

DRAFT ADVISORY

FOR ADMISSION & EVALUATION

IN

4-year Undergraduate Programme
and
3-year Undergraduate Programme

Under Curriculum and Credit Framework for

Undergraduate Programmes

Based on
National Education Policy, 2020

(To be approved by the Competent Authority)

(w.e.f Academic Session 2023-24)

WEST BENGAL STATE UNIVERSITY
DRAFT ADVISORY FOR ADMISSION TO UG PROGRAMMES UNDER NEP 2020 (2023-24)

1. Scope & Coverage

This draft advisory shall supersede the existing regulation for 3-year (Six semester) Bachelor of Arts/Science/Commerce programme under the Choice based Credit System (CBCS).

The University provides following three undergraduate programmes w.e.f. the academic session of 2023-24 under the Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) based on NEP 2020.

This advisory will be provisionally effective from the academic session 2023- 24.

A. Single Major programmes

(i) 4-year Bachelor's degree (Honours) with Major in a chosen discipline in the field of Arts/Science/Commerce/Management (8 semesters with 182 Credits) (See Table 1).

(ii) 4-year Bachelor's degree (Honours with Research) with Major a chosen discipline in the field of Arts/Science/Commerce/Management (8 semesters with 182 Credits). Students need to complete a research project of 15 credits in areas of their Major discipline in the 4th year of studies. (See Table I A)

B. Multidisciplinary programmes

(iii) 3-year Bachelor's degree with Multidisciplinary programme of studies in Life sciences/Physical sciences/Mathematical & Computer sciences/Social sciences/humanities/Commerce & Management (6 semesters with 126 credits. (See Table 2)

2. Eligibility for admission in the UG Programmes:

- A candidate who has passed the Higher Secondary (10+2) or its equivalent level examination is eligible to seek admission to the First Semester of the Eight Semester B.A./B.Sc./B.Com./BBA (Hons and Hons. with Research) or B. A. Music. (Hons. and Honours with Research) or in the First Semester of Six semester Multidisciplinary B.A./B.Sc./B.Com.

Course of studies provided he/shehas also passed with English as a subject.

- In any case, where there is an ambiguity regarding the admissibility of a particular examination at the Higher Secondary (10+2) level of study, the matter shall be referred to the Equivalence Committee of the University who shall determine the eligibility of the said examination.

- However, no candidate, opting for Honours shall be allowed for admission in the courseafter a lapse of more than 3 years from the year of passing the previous qualifying examination. Those desirous to do so need to seek prior permission from the University authority. Students desiring admission in 3 year Multidisciplinary programme shall get a total lapse of not more than 6 years. The year of admission shall not be taken into account while calculating 3 years from the year of passing the previous qualifying examination. As an example, any student successfully completing Higher Secondary (or equivalent) level education in 2020 or later are eligible for admission in Honours curricula. Similarly a student who have passed Higher Secondary (or equivalent) examination in the year 2017 or later is eligible for admission in 3 year Multidisciplinary program.

- However, in exceptional cases a candidate may be allowed for admission after 3years of the previous qualifying examination, but, within 3 years after discontinuation from a recognized regular Course of Study. Those desirous to do so will seek permission from the University Authority. ***This exception is valid for both 4-year (Hons/Hons. with Research) and 3-year Multidisciplinary UG programmes of study.***

- For the purpose of determining eligibility for admission to the **4-year Honours Course**, aggregate marks shall be calculated **by adding the marks of top four subjects** in order of marks secured by a candidate. However, marks in **compulsory Environmental Education/Studies shall not be taken into account** for calculation of aggregate marks. If the subject "Environmental Science" is studied as an elective subject of 100 marks, it may be taken into account for the purpose of determining the aggregate marks.

- For the purpose of determining eligibility for admission to the **3-year Multidisciplinary UG programme of study**, aggregate marks shall be calculated **by adding the marks of top four subjects in order of marks secured by a candidate.** However, **marks in compulsory**

Environmental Education/Studies shall not be taken into account for calculation of aggregate marks. If the subject "Environmental Science" is studied as an elective subject of 100 marks, it may be taken into account for the purpose of determining the aggregate marks.

3. Eligibility Criteria

A candidate taking up Honours in a subject must have obtained:

• A minimum of 50% marks in the aggregate and 45% marks in the subject or related subject at the previous qualifying examination. In case of Music (Hons.) 45% marks in the aggregate and 45% marks in the subject Music in the previous qualifying examination

OR

55% marks in the subject or related subject in the previous qualifying examination

OR

50% marks in the aggregate when the candidate has not studied the subject in his/her previous qualifying examination provided all other clauses are satisfied

• Candidates belonging to the Scheduled Caste or Scheduled tribe category must have obtained 40% marks in the aggregate and 40% marks in the subject/related subjects at the previous qualifying examination (10+2 level) for being eligible for admission in the Honours programme of study.

However, if in any Honours subject, the number of applications is so low that even the permitted intake of the college cannot be filled up, then the Principal/Teacher-in-charge may use his/her discretionary power to relax the minimum requirement criteria for admission in that particular subject. A written communication in that regard must reach the Registrar for consideration of that decision for final approval by the Vice Chancellor of the University and the decision will be communicated to the Dept. of Higher Education, Govt. of West Bengal.

4. Candidates from other Boards

A. Students, who have passed the Higher Secondary (10+2) examination or its equivalent from the All India Boards/Councils or State Boards/Councils including Open Schools and vocational studies,

are eligible for study at the UG level.

B. Students who have passed the Higher Secondary (10+2) examination or its equivalent from the All India Boards/Councils (i.e. CBSE, ISC and National Institute of Open Schooling) are not required to submit the Migration Certificate for getting Registration under this University.

C. Any dispute regarding eligibility criteria would be resolved by the Equivalence Committee set up by the University or by the Executive Council in its absence.

5. Choice of Courses

(A) 4-Year UG (Honours/Honours with Research) programme of study:

Candidates will have to choose a single major discipline and any two minor disciplines and the requisite numbers of AEC, SEC, MDC & VAC along with internship as shown in Table 1 & 1(A). The combination of major and two minor disciplines for the students admitted in 4 year UG(Honours/Honours with research) will be decided by the concerned college.

(B) 3-Year Multidisciplinary Undergraduate (UG) programme of study:

A candidate is required to choose **any three subjects** from **one** or **two broad** category of disciplines as offered by the concerned college.

6. Nomenclature of Degrees

As per the UGC guidelines the given nomenclatures for degrees are to be followed until further intimation from the UGC:

(A) UG Certificate: Students who opt to exit after completion of the first year and have secured the first 54 credits (Table 1, 1A) or have secured the first 42 credits (Table 2) will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits or a 4-credit work-based learning/internship/apprenticeship

during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years. The Student enrolling in 4 year UG programme will get a certificate in UG (Major); similarly, a student opting for 3 year multidisciplinary course will get a UG certificate.

(B) UG Diploma: Students who opt to exit after completion of the second year and have secured the first 98 credits (Table 1, 1A) or have secured the first 84 credits (Table 2) will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits or a 4-credit work-based learning/internship/apprenticeship during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years. The Student enrolling in 4 year UG programme will get a diploma in 4 year UG programme; similarly, a student opting for 3 year multidisciplinary course will get a diploma in 3 year UG programme. Diploma will be offered in Science/Arts/Commerce as per their Major subjects in the 4-year programme or choice of subjects in the 3-year Multidisciplinary programme.

(C) ***3-year UG Degree with Major: Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing the first 142 credits (Table 1, 1A) which includes 4-credit of summer internship/apprenticeship. The candidate will be awarded a BSc/BA/B.Com degree with Major in a specific subject eg. BSc with Physics Major.***

(D) 3-year Multidisciplinary UG Degree: A student may also opt for a 3-year multidisciplinary UG degree by securing a total credit of 126 (See Table 2) with 30 credits from each of the three disciplines. Students who wish to undergo a 3-year Multidisciplinary UG

programme will be awarded UG Degree (B.A./B.Sc./B.Com.) after successful completion of three years, securing 130 credits (Table 2) which includes 4-credit of internship/apprenticeship.

(E) 4-year UG Degree (Honours): Candidates must secure 105 credits in his /her major discipline out of the total 182 credits to obtain a Bachelor degree (Honours) in his/her major discipline (See Table1). Nomenclature of degree for 4 year UG Programme (Hons) will be based on the Major subject of choice. For example, if a student takes Physics as his Major he will get BSc degree whereas a student taking History Major will get a BA degree. The degrees to be offered after the completion of 4 year UG programme will be BSc (Hons), BA (Hons) and B.Com (Hons).

(F) 4-year UG Degree (Honours with Research): Students who secure 75% marks or above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. The students who secure 182 credits, including 15 credits from a research project/dissertation (Table 1A), will be awarded UG Degree (Honours with Research). ***Such a candidate must secure 90 credits out of the total credits of 182 from discipline-specific major courses (Table 1A) and also 15 credits through a Research project to be awarded a Bachelor degree (Honours with Research) in his/her major discipline. He/she should do a research project or dissertation under the guidance of a faculty member of that college in the Major discipline. Such candidates must submit a Thesis/Dissertation to the University for evaluation followed by a Viva-Voce examination. The concerned candidate must score 150 or above out of the 300 marks allotted for Research/Dissertation work to qualify for the degree of UG Honours with research in his/her major discipline.***

7. Broad Category of Disciplines

(i) Physical Sciences: Chemistry, Physics, Electronics.

(ii) Life Sciences: Bio-chemistry, Botany, Zoology, Physiology, Molecular biology & Bio-technology, Microbiology, Food & nutrition, Fishery Science, Anthropology, Environmental Science.

(iii) Mathematical and Computer Sciences: Mathematics, Statistics, Computer Science, Computer Application.

(iv) Social Sciences: Sociology, Political Science, History, Economics, Education, Psychology, Geography, Agriculture & Rural Development.

(v) Humanities: English, Bengali, Hindi, Urdu, Sanskrit, Arabic, Defence Studies Film Studies**,** Physical Education, Human Rights, Women Studies, Human Development, Philosophy, Journalism & Mass Communication, NCC, Music.

(vi) Commerce & Management: Accounting, Finance, Business Economics, Management and all other allied subjects; Travel & Tourism Management, Advertising & Sales Promotion.

[Note:

- **TTM & ASP can be taken by student from any stream apart from Commerce & Management. A student will get BA or B. Com degree according to his/her subject combination.**
- **Students opting for Psychology, Geography & Economics when chosen as Major subject in a 4 year UG programme will obtain BSc degree; whereas in 3 year Multidisciplinary programme the degree nomenclature will depend on the choice of other 2 Core subjects.]**

Groups of Subjects:

Gr. I: Physics, Zoology, Education, Film Studies, Physical Education, Human Rights, Women Studies, NCC

Gr. II: Mathematics, Human Development, History, Environmental Science

Gr. III: Chemistry, Sociology, Defense Studies, Music, Arabic, Sanskrit, Bio-chemistry

Gr.IV: Botany, Economics, Food & Nutrition

Gr. V: Political Science, Electronics, Fishery Science, Agriculture & Rural Development.

Gr.VI: Geography, Molecular Biology & Biotechnology, Psychology, Philosophy, Microbiology, Journalism & Mass Communication

Gr. VII: Statistics, Physiology, English

Gr. VIII: Anthropology, Computer Science, Bengali, Hindi, Urdu, Computer Application

Gr. **IX:** Commerce and allied subjects

Gr. X: Management and allied subjects with related specializations like Finance, Marketing, Human Resource Management, Systems and Operations.

Note:

(A). For the 4 year UG Programme with Honours, a candidate is required to choose his/her Major in a discipline and two other disciplines for Minor courses, from among Group-I to Group-VIII as above by taking not more than one discipline from any of the groups mentioned above.

(B). For the 3 year Multidisciplinary Course of Studies, a candidate is required to choose any three Core subjects from among the broad category of disciplines from among Group-I to Group-VIII as above by taking not more than one discipline from any of the groups mentioned above. However, the choice of the three subjects will have to be made as stated hereunder:

- ***For B.Sc. 3 year Multidisciplinary Programme, a candidate is required to choose three Core subjects from among Group I to VIII by taking not more than one subject from the same group and at least two science subjects.***
- ***For the B.A. 3 year Multidisciplinary Course of Studies, a candidate is required to choose three Core subjects from among Group I to VIII by taking not more than one subject from the same group and at least two subjects from Humanities and/or Social Sciences.***
- ***For B.Com 3 year Multidisciplinary programme three core subjects to be chosen from Commerce and allied discipline maintaining NEP norm.***

8. Mandatory Subject Requirement (at H. S. level)

A candidate shall be allowed to take up the major discipline(s) under heading "A" if he/shehad passed the subject(s) under heading "B" in the previous qualifying examination.

Sl. No	A	Sl. No	B
1	Mathematics	**1**	Mathematics
2	Statistics	**2**	Statistics/ Mathematics
3	Physics	**3**	Physics and Mathematics
4	Chemistry	**4**	Chemistry and Mathematics
5	Zoology	**5**	Zoology/ Biology/Biotechnology/Life Science
6	Botany	**6**	Botany/Biology/Biotechnology/Life Science
7	Physiology	**7**	Physiology/Biology/Biotechnology/Life Science
8	Anthropology	**8**	Anthropology/Biology/Biotechnology/Life Science
9	Molecular Biology	**9**	Chemistry/Physics and Biology/Biotechnology/Life Science
10	Microbiology	**10**	Chemistry/Physics and Biology/Biotechnology/Life Science
11	Computer Science	**11**	Mathematics/ Computer Science & Physics
12	Electronics	**12**	Electronics/Physics and Mathematics
13	Commerce	**13**	Accountancy/ Business Economics and all other allied subjects.
14	Environmental Science	**14**	Chemistry/Physics/Mathematics/Geography
15	Food & Nutrition	**15**	Chemistry and Biology/Life Science
16	Agriculture & Rural Development	**16**	Physics/ Chemistry/Biology/Economics/Anthropology/ Mathematics/Geography/Sociology
17	Geography	**17**	Geography/Economics/Statistics/Mathematics/Biology
18	Economics	**18**	Mathematics
19.	Management	**19**	Finance/Marketing/Human Resource/Systems & Operations
20	Fishery Science	**20**	Biology/ Biotechnology/Chemistry/Food & Nutrition/Physics/Life Sciences
21	Computer Applications	**21**	Computer Applications/Computer Science/Mathematics
22	Human Development	**22**	Any subject
23	Psychology	**23**	Any subject
24	BBA		Any discipline

9. Structure of the 4-year Undergraduate Programme (Honours)

Table1: Semester-wise and Course category-wise distribution of credits

SEM	Major (DSC)	Minor	MDC	AEC	SEC	VAC	Internship	Total Credits
I	DS-1(5)	MA-1(5) MB-1(5)	MD-1 (3)	AE-1 (3)	SE-1 (3)	VA-1 (3)		27
II	DS-2(5)	MA-2(5) MB-2(5)	MD-2 (3)	AE-2 (3)	SE-2 (3)	VA-2 (3)	(4**)	27
Exit with certificate								(4**) + 54
III	DS-3(5)	MA-3(5) MB-3(5)	MD-3 (3)	AE-3 (3)	SE-3 (3)			24
IV	DS-4(5),DS-5(5) DS-6(5),DS-7(5)						(4**)	20
Exit with diploma								(4**) + 98
V	DS-8(5),DS-9(5) DS-10(5), DS-11(5)							20
VI	DS-12(5), DS-13(5) DS-14(5), DS-15(5)						(4**)	20
Exit with Major	75	30	9	9	9	6		(4**)+138
VII	DS-16(5) DS-17(5)	SMA(5) SMB (5)						20
VIII	DS-18(5) DS-19(5) DS-20(5) DS-21(5)							20
Credit	105	40	9	9	9	6	4	182

DS: Discipline specific core course,

MA: Minor discipline1, MB: Minor discipline2

SM: Special Minor courses from the two different disciplines either MA or MB, but of higher level.

Credit distribution:

(a) Lab-based Courses: L=3, T/P =2, (b) Non-Lab based courses: L=4,T/P=1

(c) Field-based courses: P = 5,

(d) Music as a Major/Minor discipline, credit distribution: L = 1/2, P = 4/3

Structure of the 4-year Undergraduate Programme (Honours with Research)

Table1A: Semester-wise and Course category-wise distribution of credits

SEM	Major (DSC)	Minor	MDC	AEC	SEC	VAC	Internship/ Research	Total Credits
I	DS-1(5)	MA-1(5) MB-1(5)	MD-1 (3)	AE-1 (3)	SE-1 (3)	VA-1 (3)		27
II	DS-2(5)	MA-2(5) MB-2 (5)	MD-2 (3)	AE-2 (3)	SE-2 (3)	VA-2 (3)	(4**)	27
Exit with certificate								(4**) + 54
III	DS-3(5)	MA-3(5) MB-3(5)	MD-3 (3)	AE-3 (3)	SE-3 (3)			24
IV	DS-4(5), DS-5(5) DS-6(5), DS-7(5)						(4**)	20
Exit with diploma								(4**) + 98
V	DS-8(5), DS-9(5) DS-10(5), DS-11(5)							20
VI	DS-12(5), DS-13(5), DS-14(5), DS-15(5)						(4**)	20
Exit with Major	75	30	9	9	9	6	(4**)	(4**) + 138
VII	DS16(5), DS-17(5)	SMA(5) SMB (5)						20
VIII	DS-18(5),						15	20
Credit	90	40	9	9	9	6	19	182

DS: Discipline specific core course,

MA: Minor discipline1, MB: Minor discipline2

SM: Special Minor courses from the two different disciplines either MA or MB, but of higher level.

Credit distribution:

(a) Lab-based Courses: L=3, T/P =2, (b) Non-Lab based courses: L=4,T/P=1

(c) Field-based courses: P = 5,

(d) Music as a Major/Minor discipline, credit distribution: L = 1/2, P = 4/3

Structure of the3-YearMultidisciplinaryUGProgramme

Table2:Semester-wise and course category-wise distribution of credits

SEM	Core course(A)	Core course(B)	Core course (C)	MDC	AEC	SEC	VAC	Inten-ship	Total credits
I	MA-1(5)	MB-1(5)	MC-1(5)		AE-1(3)		VA-1(3)		21
II	MA-2(5)	MB-2(5)	MC-2(5)		AE-2(3)		VA-2(3)	(4**)	21
Exit with Certificate									(4*)+ 42
III	MA-3(5)	MB-3(5)	MC-3(5)		AE-3(3)	SE-1 (3)			21
IV	MA-4(5)	MB-4(5)	MC-4(5)	MD-1(3)		SE-2(3)		(4**)	21
Exit with diploma									(4**)+ 84
V	MA-5(5)	MB-5(5)	MC-5(5)	MD-2(3)		SE-3(3)			21
VI	MA-6(5)	MB-6(5)	MC-6(5)	MD-3(3)		SE-4(3)		(4**)	21
Credits	30	30	30	9	9	12	6	4	(4**) + 126

MA: Core course from discipline 1,

MB: Core course from discipline 2

MC: Core course from discipline 3.

Credit distribution:

(a) Lab-based Courses: L=3, T/P =2, (b) Non-Lab based courses: L=4,T/P=1

(c) Field-based courses: P = 5,

(d) Music as a Major/Minor discipline, credit distribution: L = 1/2, P = 4/3

10.Curricular components of the undergraduate programme

In accordance with NEP Curriculum & Credit Framework 2020 the undergraduate programmes governed by this Advisory contain the following course components:

- **Major and Minor disciplines**

  Major discipline is the discipline or subject of main focus and the degree will be awarded in that discipline. Students should secure the prescribed number of credits (about 50% of total credits) through core courses in the major discipline.

Minor discipline helps a student to gain a broader understanding beyond the major discipline.

In addition to major and minor disciplines, a student admitted in the 4- year Undergraduate programme (Hons./Hons. with research) has to take the following courses as shown in Table 1 & Table1A.

- **Multidisciplinary Course (MDC)** :

All UG students are required to undergo 3 different introductory-level courses relating to any ofthe broad disciplines given below. These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. Students are not allowed to choose or repeat courses already studied at the higher secondary level (12th class) and those chosen as major and minor subjects.

The university will provide a list of courses under the 5 categories mentioned in the NEP document. Students will be asked to choose 3 different MDCs in 3 semesters from the pool of courses offered by the college.

**** <u>FOR BBA COURSES MDC WILL BE PROVIDED BY THE CONCERNED UG-BOS.</u>**

Categories	Multidisciplinary Courses from the following disciplines
1.	Life Sciences/ Chemistry/ Physics/Electronics/Anthropology/ Geography
2.	Mathematics/ Statistics/Computer Application/Economics/Computer Science
3.	Library Science & Digitization/Journalism/Mass Media & Communication.
4.	Travel &Tourism/Commerce/Management/Advertisement & Sales Promotion
5.	Defence Studies/ /Psychology/Human Rights/Education/ Sociology/Political Science/Philosophy/History/ Film Studies/ Physical Education/ Women Studies/Music/Human Development/NCC

- **Ability Enhancement Course (AEC)**:

Students are required to achieve competency in a Modern Indian language and in the English language with special emphasis on language and communication skills. These courses aim at enabling the students to acquire and demonstrate the core linguistics skills, including critical reading and expository and academic writing skills, that help students

articulate their arguments and present their thinking clearly and coherently.

- **Skill Enhancement Course:**

These courses are aimed at imparting practical skills, hands-on-training, soft skills to enhance the employability of the students.

Each of the AEC and SEC courses shall carry 3 credits.

- ***Students are required to choose three different SEC courses in their 1st, 2nd and 3rd semester of study from a pool of courses offered by the college.***
- ***For AEC, they have to study three courses (each of 3 credits) of English and Modern Indian language (MIL) in their 1st, 2nd and 3rd semesters of study. In semester 1 students will take English or MIL; in semester 2 they will study a course in MIL. Those who cannot study MIL will choose English as MIL; in semester 3 all students are to study a course in English.***
- ***For 3 year Multidisciplinary UG programme 2 SECs from one discipline (SEC1 &2) and 2 from another discipline (SEC 3&4) will have to be taken.***

**** <u>FOR BBA COURSES SEC WILL BE PROVIDED BY THE CONCERNED UG-BOS.</u>**

- **Value Addition Courses (VAC):**

These are courses that will help develop all capacities of human beings – intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Each of these courses carries 3 credits. The colleges will choose ***<u>two out of the three VACs</u>*** offered by the university as mentioned hereunder.

(a) VAC 1--Environmental Studies (Theoretical)
(b) VAC2--Introduction to Cyber Security (Theoretical)
(c) VAC3--Value of Yoga and Meditation in Life (Theoretical + Practical)

Students will be required to pursue or study two value-added courses (VAC), one in their 1st and another in their 2nd semester out of the above 3 VA courses.

• **Internship:**

A course requiring students to participate in a professional activity or work experience, or cooperative educational activity with an entity external to the educational institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

The student has the option to complete a 4-credit internship in a lab, industrial organization, R & D lab, or through community engagement, NSS, NCC as organized by the college. The student must complete a 4-credit internship by his/her 5th semester of study.

Note: It is advisable to complete internship after the appropriate even semester within the gap between the end semester examination and result publication. If a student wants to leave the course with a certificate/diploma/degree, s/he should obtain the result from the college on showing the internship certificate. For a 4 year Honours a student should complete the internship within the first 6 semesters.

- **Final year Research Project / Dissertation:**

A student selected for pursuing 4-year Honours with Research programme is required to complete a research project and submit a dissertation to the University for examination and evaluation in the 8th semester. This research project/dissertation work carries 15 credits.

**** Conditions to be met by colleges offering a 4 year UG degree (Honours with Research) in a Major discipline:**

a. The departments of the college offering a 4-year UG degree

(Honours with research) must have the required infrastructure such as adequate library facility, access to internet, access to journals, computer lab and software, laboratory facilities to carry out experimental research work.

b. A full-time teacher in a substantive post holding a doctoral degree in a discipline will be able to act as supervisor for 15 credit research project at the UG level. Colleges with one faculty in a discipline capable for supervising the UG research project may take (if he/she considers it necessary) another co-supervisor from a different college under WBSU.

c. If a student becomes eligible for pursuing Honours with research in a college that lacks required infrastructure and eligible PhD supervisors, he/she may take transfer to another college, which satisfies the above conditions for offering Honours with research in the 7th semester depending on availability of seats.

11. Marks allotted for attendance:

University has allotted equal credit-based weightage to attendance for both lab and non-lab based subjects. Those with less than 55% attendance will be barred from appearing in the university examination.

12. BBA (Bachelor of Business Administration):

i) The minimum qualification for admission to the 1st year of the B.B.A. course shall be a pass in Higher Secondary (General/Vocational) from West Bengal Council of Secondary Education or any other equivalent qualification recognized by the West Bengal State University with at least 55% marks for General Candidates (50% for S.C./S.T. Candidates). There shall be no common Admission Test; instead College(s) shall hold group discussions followed by interview for such admission. There shall be option to the Colleges for holding Written Admission Test.

ii) ii) The medium of instruction for the B.B.A. course shall be English and candidates will have to answer the examination papers in English only.

iii) B.B.A. Course shall be an 8 semester course extending over four academic years. Candidates will pass out with Honours/Honours

with research.

13. Music as Major and Minor Subject:

A **i)** A candidate taking up Music as Major must get 45% marks in the aggregate and 45% marks in the subject Music, in the pre-qualifying examination.

OR

ii) 50% marks in the subject Music at the pre-qualifying examination.

OR

(iii) 45% marks in aggregate when the candidate has not studied the subject Music in the Pre-qualifying exam. Such candidates shall be admitted on the basis of the Admission Test/Screening to be conducted by the College Authority Concerned.

B) Music as a Core course in 3 year Multidisciplinary UG Programme: Any student can chose music as core subject and such a candidate shall be admitted on the basis of the Admission Test/Screening to be conducted by the concerned College Authority.

14. Credit hours for different types of courses:

- The workload relating to a course is measured in terms of credit hours. A credit is a unit by which the coursework is measured. It determines the number of hours of instruction required per week over the duration of a semester (minimum 15 weeks).
- Each course may have only a lecture component or a lecture and tutorial component or a lecture and practicum/laboratory component or a lecture, tutorial, and practicum/laboratory component, or only practicum component. For example, a three- credit lecture course in a semester means three one-hour lectures per week with each one-hour lecture counted as one credit. In a semester of 15 weeks duration, a three-credit lecture course is equivalent to 45 hours of teaching.
- One credit for tutorial work means one hour of engagement per week. In a semester of 15 weeks duration, a one-credit tutorial in a course is equivalent to 15 hours of engagement.
- A one-credit course in practicum or lab work, community engagement and services, and fieldwork in a semester mean two-hour engagement per week. In a semester of 15 weeks duration, a one-credit practicum in a course is equivalent to 30 hours of engagement.
- A one-credit of Seminar or Internship or Studio activities or Field practice/projects or Community engagement and service means two-

hour engagements per week. Accordingly, in a semester of 15 weeks duration, one credit in these courses is equivalent to 30 hours of engagement.

- A course can have a combination of lecture credits, tutorial credits, and practicum credits.
  - Lab-based Subject:

    Theory-3 credits (45 Hours); Practical-2 credits (30x2=60 Hours);Tutorial-1 credit (15 Hours).
  - Non Lab-based Subject:

    Theory-4 credits (60 Hours); Tutorial-1credit (15 Hours); Field Work-1credit (30 Hours).

15. Duration of the Programmes:

The duration of the UG programme (Honours/ Honours with research) is 4 years or 8 semesters. Students who desire to undergo a 3-year UG Programme will be allowed to exit after completion of the 3rd year. Students may be permitted to take a break from the study during the period of study but the total duration for completing the programme shall not exceed 7 years. ***The duration for Multidisciplinary UG Programme is 3 years***. The rule for total duration of completion of the programme is same as above.

16. SWAYAM Courses:

SWAYAM Courses: The University may allow up to 20% of the total courses being offered in a particular program in a Semester through the online learning courses offered through SWAYAM platform subject to the following conditions:

- The course contents should be alike;
- The courses are not offered in the College;
- There is non-availability of suitable teaching staff to run the course in the College.

The University shall give the equivalent credit weightage to the student forthe credits earned vide online learning credit courses through SWAYAM platform. ***However, the candidate will have to seek permission from the university, if he/she wants to replace regular class-teaching by Swayam course. Swayam courses will be allowed only for SEC, MDC and VAC but not for Major and Minor disciplines.***

17.Mechanism for Computation of Work-load:

The following mechanism shall be adopted for computation of work load in a semester comprising 15/16 weeks.

(a) 1Credit =1Theory period of one hour duration/week;
(b) 1Credit =1Tutorial period of one hour duration/week;
(c) 1Credit =1Practical period of two hours duration/week;
(d) 1Credit = Internship of 1 week

18.Qualification Levels and Credit Requirements:

- **For 4 year UG Honours/Honours with Research**

Semester	Qualification Title	Minimum Credit Require-ments
Completion of Sem VI	**Bachelor's Degree with Major in a discipline**	**138+ 4(int)**
Completion of Sem VIII	**Bachelor's Degree with Honours/ Honours with research in a discipline**	**182**

- **For 3 year Multidisciplinary UG Program: Minimum Credit Requirement 126+4 (internship)**

19. Course Registration:

At the beginning of every Semester, all the students shall be required to register for the Courses specified for that Semester of the Programme in the Office of the Controller of Examinations in the prescribed forms with payment of fees as prescribed by the University from time to time.

20. Post-admission Stipulations:

- Colleges have the freedom to hold any number of tests and examinations of its own students. However, colleges will not hold any elimination/qualifying test in the midway for students admitted to the different Course of Studies.

- The evaluation and assessment pattern under CCFUP based on NEP 2020 will be regulated as per provisions of the regulation which will be

in force at the time of the said examination. Any dispute regarding the above would be resolved by the relevant Examination rules and regulations set up by the University or by the Executive Council.

- It is expected that the semester examinations will be held every six months as per the academic calendar which will be duly intimated in advance by the University.

21. Foreign Nationals:

The candidate (**Foreign Nationals**) will have to show "Original Copy" of Certificate of Madhyamik (or equivalent), Certificate of Higher Secondary (or equivalent) and original Passport (along with Student Visa) at the time of admission. **Foreign Nationals will have to pay the fees five times higher than the Indian Nationals.** Their papers must be duly endorsed by the local Embassies/Consulates/High Commissions, whichever is applicable and their visa period must cover the period required to complete the course.

22. College Transfer:

Transfer of candidates from one affiliated college to another will be possible as per the provisions laid out in the regulation of NEP 2020 based CCFUP system which will be in force at the relevant time. However, in allcases such transfers will be effected after due approval of the application of the candidate concerned along with requisite non-refundable fees to the University administration without contravening the provisions of the Regulation in force. ***All applications for transfer have to be made to the University authority within 30 consecutive days of commencement of the relevant semester. The applications must also contain the attendance of the student in that semester.*** The University reserves the right to approve or reject such applications of transfer and it cannot be treated as a matter of right on behalf of the applicant concerned.

23. Re-admission:

In case of discontinuation of Studies, the candidate concerned can be permitted only fresh admission with the issuance of new Registration (in cancellation of the earlier registration) after submission of an affidavit from a 1st class Judicial Magistrate that he/she has not taken admission under any other University/Institution in the intervening period. All such cases of fresh admission have to be preceded with the cancellation of earlier registration. For all such re-admission the provisions of this regulation in consonance with

the Act and Statute of the University and the guidelines issued by the West Bengal Higher Education Council from time to time should be followed. However, after an exit at the end of the 3rd year after completion of stipulated 6 semesters mentioned in Table.1, the candidate will not have to re-register if he wants to complete the course within 7 years from the date of exit.

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- **The student can enter within 7 years to complete the course but not in the same session after exiting. Intra-college exit will not be allowed.**
- **All disputes relating to evaluation will be resolved by the local jurisdiction.**
- **Since this a credit point based evaluation system there is no linear relationship between the full marks of a component and the credit allotted.**
- **The Distribution of the Courses and the marks for the different components have been done in a manner such that the University component and the College component of the Weighted Grade Point is exactly same for students pursuing both Lab and Non-Lab based courses.**

- **MAJOR & MINOR/CORE**

- **FOR LAB BASED SUBJECTS: THEORY (3 credit) + PRACTICAL (2 credit)**
  MARKS ALLOTTED: 50 (Theory) + 50 (Practical)

Theory : Total marks = 50

- The total marks for the theoretical component shall be 50 which will be evaluated by the University in the form of an End Semester Examination.

Practical - Total Marks 50

- The total marks shall be 50 of which 25 marks will be evaluated by the University and 25 marks will be evaluated by the respective colleges.
- The End Semester examination for Core papers (4 year Honours) will be conducted by the university, and will consist of 25 marks which will be sub-divided as follows : Lab Note Book -5, End semester evaluation -20 (by a method as decided by the respective BOS). The other 25 marks will be sub-divided as follows : Attendance (considering both the theory and the practical classes) -5, Continuous Assessment/Internal Assessment (CA/IA)-20.
- The Minor papers (4 year Honours) and Core papers (3 year

Multidiscipinary) will be evaluated by the college as per guidelines from the respective BOS, and will consist of 25 marks in a method as decided by the respective BOS. The other 25 marks will be sub-divided as follows: Attendance (considering both the theory and the practical classes) -5, CA/IA-20.

Final marks out of 50 in this course will be decided by the formula $(3 \times M_T + 2 \times M_L)/5$, **where M_T is the marks obtained in the theoretical component and M_L is the marks obtained in the practical component.**

- **FOR NON LAB-BASED SUBJECTS: THEORY (4 credit) + TUTORIAL (1 credit)**
  MARKS ALLOTTED: 50 (Theory) + 50 (Tutorial)

Theory : Total marks = 50

- The total marks for the theoretical component shall be 50 which will be evaluated by the University in the form of an End Semester Examination.

Tutorial - Total Marks 50

- The total marks shall be 50 which will be evaluated by the respective colleges.
- The evaluation of the 50 marks by the college will be sub-divided as follows :
  Attendance-10, Presentation/Home assignment-20, CA/IA (Written Examination)-20.

Final marks out of 50 in this course will be decided by the formula $(4 \times M_T + 1 \times M_{TU})/5$, **where M_T is the marks obtained in the theoretical component and M_{TU} is the marks obtained in the tutorial component**

- **PASS MARKS**

- For subjects with practical the student will have to secure 40% in theoretical and 40% in practical separately in order to qualify ***subject to the condition that out of this qualifying percentage, 30% must be secured in the end semester examination.***

If a candidate fails to obtain at least 40% in the theoretical component then

he/she needs to reappear in a subsequent examination for a fresh evaluation.

If a candidate fails to obtain at least 40% in the laboratory component then he/she needs to reappear only in the end semester component of the course for a fresh evaluation. The internal component (marks allotted by the college) will be carried forward.

- For subjects without practical the student must secure 40% in a paper ***subject to the condition that 30% must be obtained in the end semester examination. In other words, a student securing 40% from internal marks only will not qualify in the examination.***

➢ **MDC—50 MARKS**

Evaluation by colleges. Evaluation pattern to be decided by the respective UG-BOS.

**** FOR BBA COURSES MDC WILL BE PROVIDED BY THE CONCERNED UG-BOS.**

➢ **SEC—50 MARKS**

- Evaluation by colleges. Evaluation pattern to be decided by respective UG-BOS.

**** FOR BBA COURSES SEC WILL BE PROVIDED BY THE CONCERNED UG-BOS.**

➢ **AECC—50 MARKS**

- End semester examination on the basis of 25 MCQ will be taken by the university.

➢ **VAC—50 MARKS**

- End semester examination on the basis of 25 MCQ will be taken by the university for courses on Environmental Studies & Introduction to Cyber security.
- For Value of Yoga & Meditation an end semester examination on 20 MCQ questions will be taken by the university. The colleges will send practical marks on 10 to the university.
- Questions from all three optional VA courses will be set in each of the first two semesters. **There will be a common UG-BOS for the 3 VA courses which**

will decide names of paper setters, moderators and examiners for Yoga practical.

**** ALL VA COURSES ARE THEORETICAL EXCEPT YOGA & MEDITATION (2 CR THEORY + 1 CR PRACTICAL)**

➢ HONOURS WITH RESEARCH

- Students who secure an average of 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year for obtaining a Bachelor degree (Honours with Research) in his/her major discipline.
- Such candidates must secure **95 credits** out of the total credits of **182** from discipline-specific major courses and also needs to secure 15 credits through a Research project to be awarded a Bachelor degree (Honours with Research) in his/her major discipline.
- A student selected for pursuing 4-year Honours with Research programme is required to complete a research project and submit a dissertation to the concerned university department for examination and evaluation in the 8th semester.
- **The concerned UG-BOS will form a board comprising one university faculty, one external expert and the supervisor. This research project/dissertation work carries 15 credits and 300 marks.**
- The concerned candidate must score **150** or above out of the 300 marks allotted for Research/Dissertation work for being awarded the degree of UG Honours with Research in his/her major discipline.
- Plagiarism check for dissertation/project report should be done by the candidate from the university library against a fee, and the report should be attached with the dissertation/report maintaining UGC norms. Dissertation with similarity index more than 10% as per UGC norms will be referred back to the concerned board for decision.
- A full-time teacher in a substantive post holding a doctoral degree in a discipline will be able to act as supervisor for 15 credit dissertation/ research project at the UG level. Colleges with one faculty in a discipline capable for supervising the UG research project may take another co-supervisor from a different college under WBSU.
- **Evaluation of the Dissertation/Project report to be done separately by the supervisor and the external expert assigned by the concerned Board and an average of the two marks to be allotted. The presentation and Viva will be evaluated jointly by the supervisor, external expert and university faculty.**

Guidelines for Dissertation/Project Report:

- **Word count-5000 excluding bibliography**
- **Font—Times New Roman 12**
- **Line Spacing—1.5**
- **Referencing—Any standard referencing format as per subject requirement (MLA/Chicago/APA or as deemed suitable)**
- **Footnotes/Endnotes wherever applicable.**

Evaluation of Dissertation/Project Report:

- **Dissertation/Project Report—200**
- **Presentation—50**
- **Viva Voce—50**

- **GUIDELINES FOR 4-CREDITS INTERNSHIP PROGRAMME/WORK-BASED VOCATIONAL PROGRAMME AS PER UCCF**

[For 4-Years' Undergraduate Programme with Major/Research and/or for 3 Years' Undergraduate Programme with Multidisciplinary Courses]

Internship as per NEP 2020

It has been envisaged in the National Education Policy 2020 (NEP 2020) that a student shall undergo internship at the undergraduate level. This course, as enshrined in the NEP2020 will require a student to undergo "professional activity or work experience, or cooperative education activity with an entity external to t/he education institution", normally this activity will be under the supervision of an expert belonging to the external institution/agency. Such an agency maybe industry, government organizations/NGOs, commercial organization, research laboratories, crafts persons etc. Students shall also be expected to maintain daily logs detailing their day-to-day activity in details along with a 1000 words report.

Objectives of Internships

The main aim of the internship is to expose the student to "real-life" working situation or as per NEP, "on-site experiential learning". Briefly the following objectives may be put forward:

- To experience in professional environment, which otherwise cannot be simulated in a classroom.
- To explore career alternatives and obtain hands on training.
- To apply knowledge to practice
- To explore and put to test ones potentialities
- To develop respect towards a profession
- To develop integrate work culture in character
- To work in a group for a common goal
- To develop communication skills and working in a group
- To develop the art of reporting/registering/documenting an activity
- To develop self confidence and self respect

Guidelines for organizing Internship

As per present UCCF a student intended to do the internship in the fifth (5) semester, can engage herself/himself in an internship under NCC/NSS/Industrial Internship/Research Internship/ local administration as per the following schedule:

Name	Duration	Nature of Internship Project	No. of Credits
Internship Assessment through Projects	**120 hours**	**Intra/Inter-Institutional Activities related to NSS/NCC Or Industrial/NGO/MSME/Rural Internship/Innovation/Incubation Center/ Local administration/Research Laboratory**	**4**

Assigning the Students for Internship

The students entitled for the Internship must be duly nominated/assigned by the HOD of the concerned Department from, choices mentioned in Table 1, and should be

forwarded by the competent authority of the College.
Step 1: It is advisable that the college procure proper written agreement of the institution/agency (please refer to Table1) well in advance of the commencement of the internship. The College may take a prior survey of the student's need/interest/choice.

Step 2: There should be a proper documentation of the allocation of the internship eg. Allocation letter/ consent letter from institution/agency under which the internship will be performed. All such documentation should be preserved by the College.

Step3: Students joining letter to the internship program issued by host institution/agency should be preserved by College.

Step 4: The host College must ensure the submission of a detailed project report (1000 words) describing the objectives, the work done during the internship and its practical/social impact. The student shall also maintain a daily log book detailing her/his daily activity. This report should also mention the total hours spent in the activity.

Step 5: After successful completion of Internship the College along with the host institution/agency (under which the internship was completed) will evaluate the students' performance.

Step 6: Certificate of completion and experience should be issued by College along with the host institution/agency (under which the internship was completed).

Important points for evaluation

The daily log book is to be signed by candidate and supervisor under whom the internship is being done. This shall serve as proof of attendance and shall be required to be submitted to the College.
Evaluation should take into account:

1. Regularity and timely attendance (maintained in log book)
2. Proper documentation (as per 1000 word report and log book)

Allocation of Marks

The total marks allocated will be 50 marks sub-divided into:

1. The Internship Mini Project Report – 30 Marks
2. Viva-voce by college 20 Marks

- **LETTER GRADE & GRADE POINT:**

1. **Letter Grade and Grade Point:**
The 10-point grading system of the UGC, as described below, will be adoptedfor assessment and examination of the performance of students in various courses of the undergraduate programmes.

Letter Grade is used to signify the level of qualitative/quantitative academic achievement of a student in a Course, while the **Grade Point** is used
to indicate the numerical weight of the Letter Grade on a 10-point scale. Letter Grades 'O' to 'P'indicate successful completion of a Course, while Letter Grades 'F' and 'Ab' indicate 'fail' and 'Absent' respectively.

Table : Letter Grades and Grade Points

Letter Grade	**Grade Point**	**% of Marks**	**SGPA/CGPA**	**Description**
O (Outstanding)	10	90 – 100	9.0 – 10.0	Outstanding
A+ (Excellent)	9	80 – less than 90	8.0 – less than 9	First Class Exemplary
A (Very Good)	8	70 – less than 80	7.0 – less than 8	First Class Distinction
B+ (Good)	7	60—less than 70	6.0 – less than 7	First Class
B (Above Average)	6	55 – less than 60	5.5 – less than 6	High Second Class
C (Average)	5	50 – less than 54	5.0 – less than 5.4	Second Class
P (Pass)	4	40 – less than 50	4.0 – less than 50	Pass
F (Fail)	0	Less than 40	Less than 4.0	Fail
Ab	0	---	---	Absent

COMPUTATION OF SGPA AND CGPA:

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci
Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	B	6	4 X 6 = 24
		20			139
	SGPA				139/20=**6.95**

ii. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = $\sum$(Ci x Si) / $\sum$ Ci

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6
Credit: 21 SGPA:6.9	Credit: 22 SGPA:7.8	Credit:25 SGPA:5.6	Credit: 26 SGPA:6.0	Credit: 26 SGPA: 6.3	Credit 25 SGPA 8.0

COURSE CODING WITH EXAMPLES

➢ **Principle behind subject coding under NEP (Total 10 places):**

- First 3 letters : Existing subject code
- 4th to 6th letters : Nature of course

  MIN – Minor Subject; DSC – Discipline specific core in 4 yr UG; SEC – Skill enhancement course—HSE/GSE (H for Hons/G for 3 yr Multidisciplinary); COR – Core paper in Multidiscipline 3 yr UG; RES-Research; MDC-multidisciplinary courses—HMD/GMD; VAC-value added courses; AEC-ability enhancement courses—HAE/GAE; INTERN-Internship; SMC –Special Minor for Hons.
- 7th Letter : Semester No.
- 8th & 9th Letters : Course No.
- 10th Letter : Type of course (T; P ; M).

  [T-theoretical; P-practical; M-mixed type]

➢ **Code for Major, Minor & Core Papers:**

Examples—HINDSC101T; ENGMIN202T; HISCOR404T

➢ **Coding for Value added courses:**

- Environmental Studies – VAC 1 (EVSVAC101T)/(EVSVAC201T)
- Introduction to Cyber Securities – VAC2 (ICSVAC202T)/(ICSVAC102T)
- Value of Yoga and Meditation in Life – VAC3 (VYMVAC203M)/ (VYMVAC103M)

➢ **Hons with Research** : Eg. ENGRES801T/GEORES801M

➢ **Internship—**INTERN301M/INTERN101M

➢ **Special Minor in 7th Semester for Honours Students:**
Egs. EDUSMC701; ENGSMC701T

➢ **For MDC, AEC & SEC-- H: Honours; G: Multidisciplinary. In case of MDC and SEC a course will have multiple codes.**

- MDC in 1st, 2nd,3rd Semesters for Hons-- example ECOHMD301M i.e, Economics as MDC in 3rd Sem; for Multidisciplinary Programme at Sem-4th, 5th, 6th –example EDUGMD601M i.e, Education as MDC in 6th Semester. A detailed example is worked out with Life Science MDC.

  LIFHMD101M if taken in Sem I for Honours or Honours with Research

  LIFHMD201M if taken in Sem II for Honours or Honours with Research

  LIFHMD301M if taken in Sem III for Honours or Honours with Research

  LIFGMD401M if taken in Sem IV for Graduation in Multidisciplinary Program

  LIFGMD501M if taken in Sem V for Graduation in Multidisciplinary Program

  LIFGMD601M if taken in Sem VI Graduation in Multidisciplinary Program

- SEC in Multidisciplinary UG Programme in Sem 3rd , 4th , 5th , 6th (2 course in Sem- 3, 4 from one subject and 2 courses in Sem-5,6 from another subject). Examples ENGGSE301M & ENGSE402M/ CEMGSE501M & CEMSE602M

- SEC in Honours Course in Sem 1st ,2nd, 3rd (3 SEC courses will have to be taken.). Examples ENGHSE101M, BNGHSE202M, PLSHSE303M.

  [While the courses remain the same the codes will change to indicate the semesters in which they are offered. This is required in a structure that is offering multiple exits.]

- AEC for Hons and Multidisciplinary in 1st, 2nd, 3rd Semesters English or Modern Indian Language (MIL)-- Bengali, Urdu, Hindi.
  Examples ENGHAE101T/ENGGAE101T;HINHAE101T/HINGAE101T.
