



UNIVERSITY OF CALICUT

**Abstract**

General and Academic - Faculty of Science - Syllabus of MSc Microbiology Programme under CBCSS PG Regulations 2019 with effect from 2019 Admission onwards -Implemented- Orders Issued.

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**G & A - IV - J**

U.O.No. 8861/2019/Admn

Dated, Calicut University.P.O, 05.07.2019

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*Read:-*1. U.O.No. 4487/2019/Admn dated 26.03.2019

2. Minutes of the meeting of the Board of Studies in Microbiology held on 08.04.2019

3. Item No. I.10 in the minutes of the meeting of Faculty of Science held on 27.06.2019

**ORDER**

The Regulations for Choice Based Credit and Semester System for Post Graduate (PG) Curriculum-2019 (CBCSS PG Regulations 2019), for all PG Programmes under Affiliated Colleges and SDE/Private Registration with effect from 2019 Admission has been implemented in the University of Calicut vide paper read first above.

The meeting of the Board of Studies in Microbiology held on 08.04.2019 has approved the Syllabus of MSc Programme in tune with new CBCSS PG Regulations implemented with effect from 2019 Admission onwards, vide paper read second above.

The Faculty of Science at its meeting held on 27.06.2019 has approved the minutes of the meeting of the Board of Studies in Microbiology held on 08.04.2019, vide paper read third above.

Under these circumstances, considering the urgency, the Vice Chancellor has accorded sanction to implement the Scheme and Syllabus of MSc Microbiology Programme in accordance with the new CBCSS PG Regulations 2019, in the University of Calicut with effect from 2019 Admission onwards, subject to ratification by the Academic Council.

The Scheme and Syllabus of MSc Microbiology Programme in accordance with CBCSS PG Regulations 2019, is therefore implemented in the University with effect from 2019 Admission onwards.

Orders are issued accordingly. ( Syllabus appended )

Biju George K

Assistant Registrar

To

The Principals of all Affiliated Colleges

Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE V/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

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Section Officer



UNIVERSITY OF CALICUT

**M.Sc. Microbiology (CBCSS) Syllabus**

**For affiliated colleges**

**2019 Admission onwards**

## Detailed Scheme for the M. Sc. Microbiology (CBCSS) course 2019

Course		Contact Hours/Week	Credit	Exam Duration	Weightage	
					Ext	Int
Semester I	1. MBGIC01. General Biochemistry and Microbial Metabolism	4	4	3 Hours	4	1
	2. MBGIC02. Biophysics and Instrumentation	3	3	3 Hours	4	1
	3. MBGIC03. Environmental and Sanitation Microbiology	3	3	3 Hours	4	1
	4. MBGIC04. Agricultural Microbiology and Plant Pathology	3	2	3 Hours	4	1
	5. MBGIL01. Practical I	6	4	1 day x 5 Hours	4	1
	6. MBGIL02. Practical II	6	4	2 days x 5 hours	4	1
<b>Total</b>		<b>25</b>	<b>20</b>			
Semester II	7. MBG2C05. Principles of Genetics	5	4	3 Hours	4	1
	8. MBG2C06. Food and Dairy Microbiology	5	4	3 Hours	4	1
	9. MBG2C07. Industrial Microbiology	4	4	3 Hours	4	1
	10. MBG2C08. Immunology	5	4	3 Hours	4	1
	11. MBG2L03. Practical III	6	4	2 days x 5 hours	4	1
	<b>Total</b>		<b>25</b>	<b>20</b>		
Semester III	12. MBG3C09. Medical Microbiology	5	4	3 Hours	4	1
	13. MBG3C10. Molecular biology	4	4	3 Hours	4	1
	14. MBG3E01. Diagnostic microbiology	4	4	3 Hours	4	1
	15. MBG3E02. Cell Biology					
	16. MBG3E03. Microbial Taxonomy					
	17. MBG3L04 Practical IV	6	4	2 days x 5 hours <sup>1</sup>	4	1
18. MBG3L05. Practical V	6	4	2 days x 5 hours <sup>2</sup>	4	1	
<b>Total</b>		<b>25</b>	<b>20</b>			
Semester IV	19. MBG4C11. Biostatistics and Bioinformatics	4	4	3 Hours	4	1
	20. MBG4E04. Microbial Biotechnology	4	4	3 Hours	4	1
	21. MBG4E05. Genetic engineering					
	22. MBG4E06. Biosafety, Bioethics and IPR					
	23. MBG4L06. Practical VI	6	4	1 day x 5 Hours	4	1
	24. MBG4P. Dissertation	11	8	1 day x 5 Hours	4	1
<b>Total</b>		<b>25</b>	<b>20</b>			
<b>Grand Total</b>			<b>80</b>			
Audit Course I: Ability Enhancement Course (AEC)		No workload	4			
Audit Course II (PCC): Professional Competency Course (PCC)			4			

## WEIGHTAGE DISTRIBUTION OF EXAMINATIONS AND PROJECT WORK

### Theory examination (Internal)

	Percentage	Weightage
Test paper	40	2
Seminar/Presentation	20	1
Assignment	20	1
Attendance	20	1

### Practical examination (Internal)

	Percentage	Weightage
Lab skill	40	4
Record/Viva	30	3
Practical Test	30	3

### Practical examination (External)

		Percentage	Weightage
Experiment	Principle/Procedure	10	1
	Major Experiment	20	2
	Minor Experiment	30	3
	Spotters	10	1
Record		10	1
Viva		20	2

### Dissertation

Sl . No	Criteria	% of weightage	Weightage External	Weightage Internal
1	Relevance of the topic and Statement of problem	60%	8	2
2	Methodology & Analysis		8	2
3	Quality of Report & Presentation		8	2
4	Viva-voce	-40%	16	4
	Total Weightage	100%	40	10

### Question paper

	Number of questions	Weightage	Total
Short Answer	14 out of 14	1	14
Short essays	7 out of 10	2	14
Essays	2 out of 4	4	8
<b>Total:</b>			<b>36</b>

**M.SC. MICROBIOLOGY (CBCSS)**

**SYLLABUS 2019**

**Semester I**

1. MBG1C01. General Biochemistry and Microbial Metabolism
2. MBG1C02. Biophysics and Instrumentation
3. MBG1C03. Environmental and Sanitation Microbiology
4. MBG1C04. Agricultural Microbiology and Plant Pathology
5. MBG1L01. Practical I
6. MBG1L02. Practical II

**Semester II**

7. MBG2C05. Principles of Genetics
8. MBG2C06. Food and Dairy Microbiology
9. MBG2C07. Industrial Microbiology
10. MBG2C08. Immunology
11. MBG2L03. Practical III

**Semester III**

12. MBG3C09. Medical Microbiology
13. MBG3C10. Molecular biology
14. MBG3E01. Diagnostic microbiology
15. MBG3E02. Cell Biology
16. MBG3E03. Microbial Taxonomy
17. MBG3L04 Practical IV
18. MBG3L05. Practical V

**Semester IV**

19. MBG4C11. Biostatistics and Bioinformatics
20. MBG4E04. Microbial Biotechnology
21. MBG4E05. Genetic engineering
22. MBG4E06. Biosafety, Bioethics and IPR
23. MBG4L06. Practical VI
24. MBG4Pr. Dissertation

## **SEMESTER I**

### **MBG1C01. General Biochemistry and Microbial Metabolism**

**Unit 1:**-Structure and functions of Biomolecules: - Structure, classifications and functions of carbohydrates- Monosaccharides; Disaccharides and polysaccharides.. Heteropolysaccharides, Glycosaminoglycans and Glycoproteins. Structure and functions of amino acids and proteins: - Chemical structures and classifications of amino acids. Chemical properties of amino acids; Lipids –structure, properties and classification. Fatty acid classification- Saturated, unsaturated and poly- unsaturated fatty acids (PUFA); Short chain, medium chain and long chain fatty acids. Phospholipids and Sphingolipids; prostaglandins, prostacyclins and leukotriens. Hormones and vitamins -structure and functions.

**Unit 2:**-Carbohydrate metabolism: Respiration and fermentation. Respiration – aerobic and anaerobic respiration. Glycolysis- aerobic and anaerobic types; alcoholic fermentation; regulation of glycolysis. Pyruvate dehydrogenase complex; Krebs cycle; Glyoxylate cycle- significance, regulation; Phosphorylation – substrate level and oxidative phosphorylation. Electron transport chain- components and mechanism of ATP formation; Chemi-osmotic coupling hypothesis. Gluconeogenesis. Glycogenesis and glycogenolysis. Peptidoglycan biosynthesis.

**Unit 3:**-Amino acid metabolism- Transamination, deamination, transmethylation and decarboxylation. Glucogenic and ketogenic amino acids, Microbial metabolism of glycine, phenylalanine and lysine.

**Unit 4:**-Lipid metabolism-Fatty acid oxidation; alpha, beta, and omega oxidations; Fatty acid synthesis; synthesis of unsaturated and long chain fatty acids.

**Unit 5 :** Nucleic acid metabolism - Biosynthesis and degradation of purines and pyrimidines- de novo and salvage pathways.

**Unit 6:**-Enzymology- Enzyme–IUB-Nomenclature; Classification; Enzyme active sites; coenzymes and co-factors; Factors affecting enzyme activity, Enzyme kinetics - Michaelis-Menton equation Multi-subunit enzymes; isozymes; allosteric enzymes; enzyme regulation; Enzyme inhibition; Mechanism of Enzyme action; Enzyme purification techniques. Enzyme immobilization.

**MBG 1C02: Biophysics And Instrumentation**

**Unit I :** Structure of atoms, molecule, Physico-chemical forces- ions, ionic bonds, covalent bonds, Hydrogen bonds, vander Walls forces, hydrophobic interactions, polar and non-polar molecules. Laws of thermodynamics, the concept of enthalpy, entropy and free energy, thermodynamic equilibrium, redox potential, high energy molecules, examples of redox potential in biological system. DNA-Protein interaction-. Lambda repressor and cro binding to DNA. Interactions of transcription factors-HLH, bHLH, Leucine Zipper, Cys-His, Zinc fingers. Histone-DNA interaction, RNA protein interactions, DNA-drug Interaction.

**Unit II:** Structural implication of peptide bond, Ramachandran plot, protein families, alpha domains, beta-domains, alpha- beta domains, Protein-drug interaction. peptide mass finger printing using MALDI-TOF, MASCOT database.

**Unit III:** Principle, Instrument Design, methods and Applications of Microscopy: Light, Scanning and Transmission electron, phase contrast, polarization, confocal and interference microscopy, CCD camera, Introduction to Atomic force microscopy. Beer-Lamberts law, Principle, Instrument Design, methods and Applications of UV-Visible spectra, IR spectra, Raman Spectra, Fluorescence spectra, NMR and ESR spectra. Colorimetry, spectrophotometry, Flourimetry, Flame photometry and Spectroscopy. Xray diffraction technique-principle and application.

**Unit IV :** Principle, Instrument Design, methods and Applications of Chromatography, ion exchange, molecular sieve, affinity chromatography, paper, TLC, GC, HPLC, HPTLC, FPLC, GC-MS, LC-MS. Centrifugation and Ultracentrifugation, Centrifugation - Principle and application of various types of centrifugation. Electrophoresis- AGE, PAGE- SDS & Native PAGE, Capillary Electrophoresis, isoelectric focusing, 2D Electrophoresis.

**Unit V:** pH meter- principle, types and applications. Dialysis-principle and applications. Principle, methods and Applications of Ultra filtration, Sonication, Lyophilization. Refractometry, Cytometry and Flow cytometry, Introduction to Radioactive isotopes, autoradiography, radiation dosimetry- GM counter, Liquid scintillation counting, safety aspects. Biosensors.

### **MBG1C03. Environmental and Sanitation Microbiology**

Unit 1 : Microbial Ecology: Microbial Communities. Basic concept of ecosystem, Ecological niches, Microbial succession- Primary and secondary succession. Microbial interactions- Neutralism, commensalism, symbiosis, synergism, competition, parasitism, antagonism and predation. Bio-geochemical cycles- C,N, S, P and Fe.

Unit 2 : Air microbiology: Air microflora- transient nature of air flora, droplet nuclei and aerosols. Methods of air sampling and types of air samplers – impaction on solids, impingement technique in liquid, sedimentation, centrifugation, precipitation and thermal precipitations. Air sanitation- methods and applications.

Unit 3 : Water Microbiology: Fresh water and marine microbial populations; potable water and indicator microorganisms, Bacteriological analysis of drinking water and other quantitation techniques; drinking water purification. Waste water- Sources, types, composition and characteristics (DO, BOD, COD) . Microbiology of waste water. Sewage treatment.

Unit 4: Pollution and Environment: Biosensors and environmental applications. Pollution- Soil, Air, Water and Marine pollution. Solid waste management – land filling and composting. Biogas production. Treatment of petroleum waste and xenobiotic. Biodegradation of recalcitrant. Bioleaching – General mechanism, Bioleaching of Copper, Uranium, and Gold.

### **MBG1C04. Agricultural Microbiology and Plant Pathology**

Unit 1: Microbial interactions: Microbial flora of soil. Plant – Microbe interactions :- .Nitrogen fixation- Symbiotic and non-symbiotic, physiology and genetics of nitrogen fixation. Mycorrhizae, Rhizosphere and Phylloplane microorganisms. Animal-Microbe Interactions - Rumen microflora, Nematophagous fungi, Bioluminescent bacteria, Termite nutrition

Unit 2: Applications of microbes in agriculture: Biofertilizers. Symbiotic nitrogen fixation - (Rhizobium, Frankia). Symbiotic nutrient mobilizers - Endomycorrhizae and Ectomycorrhizae. Non symbiotic microbes – Azotobacter. Associative Symbiosis – Azospirillum. Cyanobacteria (Nostoc, Gloeocapsa), Azolla-Anabaena System. Mass



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production of biofertilizers. Bio pesticides- bacterial, fungal and viral. Advantages and disadvantages of bio pesticides over the chemical counter parts. GM crops and its significance.

Unit 3: Plant pathology: Components of disease (disease pyramid). Symptoms, epidemiology and control of common plant diseases. Fungal diseases- Late blight of potato, Downy mildew of grapes, Powdery mildew of cucurbits, Early blight of potato, Rice blast, Red rot of sugarcane, Sheath blight of rice, Rusts of wheat. Bacterial diseases – Crown gall disease and Ti plasmid, BLB of rice, Red stripe of sugarcane, Bacterial wilt of Banana (Moko disease), Soft rot of potato, Citrus canker, Ratoon stunting of sugarcane.

Unit 4: Mycoplasma – Coconut root wilt. Viral diseases – Tobacco mosaic, Yellow vein mosaic of Bhindi, Rice Tungro, Leaf curl of papaya, Bunchy top of banana, Potato spindle tuber, Coconut Cadang- Cadang. Nematode- Potato cyst nematode. Plant defense mechanisms- Structural, biochemical, SAR and ISR.

### **MBG1L01. Practical I**

#### **(General Biochemistry and Microbial Metabolism)**

1. Preparation of solutions – Percentage, Molar, Normal and dilution of stock solutions
2. Preparation of buffers.
3. Estimation of Glucose by ortho toluidine method
4. Estimation of fructose by Roe – Pappadapoulose Method
5. Estimation of reducing sugars by DNS method
6. Qualitative identification of carbohydrates in mixture containing mono, di and polysaccharides.- starch, dextrin, sucrose, maltose, lactose, glucose, fructose, xylose and galactose.
7. Estimation of amino acid, methionine by nitroprusside method.
8. Protein Estimation using Lowry's method.
9. Protein estimation by Bradford's method.
10. Estimation of ascorbic acid in plant matter
11. Estimation of citric acid
12. Estimation of cholesterol by Zak's method

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13. Bacterial synthesis of PHB and its estimation
14. Demonstration of siderophore production by microbes
15. Spectrophotometric assay of enzyme activity.
16. Determination of  $K_m$  and  $V_{max}$ .
17. Effect of pH and temperature on enzyme activity - amylase SDS PAGE using protein Standards
18. Gel filtration chromatography
19. Dialysis of proteins
20. Paper chromatography
21. TLC
22. Column separation of plant pigments
23. Fractionation of egg protein and its identification

**MBG1L02. Practical II**

**(Biophysics and Instrumentation, Environmental and sanitation microbiology & Agricultural Microbiology and plant pathology)**

1. Study of air microflora by plate exposure and liquid entrapment
2. Cultivation of fungi - Slide culture technique.
3. Water potability testing by Most Probable Number technique
4. Determination of DO, BOD and COD
5. Efficiency testing of bacteria proof filters and autoclave.
6. Anaerobic culturing by liquid paraffin overlay and pyrogallol.
7. Anaerobic enrichment of cellulose digesters
8. Winogradsky column.
9. Demonstration of Microbial Bioluminescence.
10. Phage cultivation
11. Microbial flora from different soil types and habitats – bacterial and fungal
12. Isolation of actinomycetes from soil.

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13. Detection of R:S ratio by estimating rhizosphere population.
14. Assay of extracellular enzymes– cellulase, protease, lipase and phosphatase
15. Isolation of nitrogen fixing bacteria, *Rhizobium*.
16. Isolation of non symbiotic nitrogen fixing bacteria.
17. Isolation of *Azospirillum*
18. Isolation of phosphate solubilizing organisms.
19. Cultivation of *Azolla*
20. Isolation of biocontrol agents, *Pseudomonas fluorescence* and *Trichoderma*
21. Microflora of termite gut- isolation of cellulose degrading bacteria and direct microscopic examination of protozoa
22. Demonstration of microbial antagonism
23. Bioassay of Bti and Bt
24. Comparison of microflora in Bt-treated and chemical pesticide-treated soils
25. Microbial degradation of phenols
26. Phosphate, nitrogen and metal removal by microbes

## **SEMESTER II**

### **MBG2C05. Principles of Genetics**

**Unit I: Introduction to Classical genetics:** Pre- Mendelian genetic concepts: Preformation, Epigenesis, Inheritance of acquired characters and Mutation theory. Heredity and Environment: Concepts of Phenotype, Genotype, Heredity, variation, Pure lines and Inbred lines. Biography of Mendel and his experiments on pea plants. Law of Segregation: Monohybrid cross, Back cross and Test cross, Problems related. Law of Independent Assortment: Dihybrid cross in pea plant, Back cross and Test cross, Problems related. Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems related. Gene Interactions. Deviations from Mendelism: Incomplete inheritance and Codominance. Inter allelic: Complementary gene interaction (9:7) Ex: *Lathyrus odoratus* Supplementary gene interaction (9:3:4) Ex: Grain color in Maize. Epistasis - Dominant Ex.: Fruit color in *Cucurbita pepo*, Recessive - Ex.: Coat color in Mice. Non- Epistasis - Ex.: Comb pattern in Poultry.

**Unit II: Sex linkage in Genetics:** Meiotic behavior of chromosome and non - disjunction. Theory of non-disjunction. Sex linked inheritance in man (Colour-blindness, Haemophilia). Attached X-chromosome. Chromosome theory of Sex determination: XX- XY, XX-XO, ZZ-ZW

Environment and sex determination. Hormonal control of Sex determination. Gynandromorphs Dosage compensation in *Drosophila* and Man (Lyon's hypothesis). Inheritance of Mitochondrial DNA and Chloroplast DNA

**Unit III: Linkage and Crossing over:** Linkage: Definition of Linkage, Coupling and Repulsion hypothesis. Types of linkage-complete linkage and incomplete linkage. Factors affecting linkage- distance between genes, age, temperature, radiation, sex, chemicals and nutrition. Crossing over: Crossing over- definition and types of crossing over: Germinal and Somatic crossing over. Cytological basis of crossing over: Stern's experiments in *Drosophila*. Mechanism of crossing over: Chiasma type theory, Breakage first theory, Contact first theory, Strain or torsion theory. Molecular mechanism of crossing over - Holiday model, Crossing over in *Drosophila*. Interference and coincidence, Steps in Construction of genetic map.

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**Unit IV: Chromosomal aberrations:** Numerical: Euploidy (Monoploidy, Haploidy and Polyploidy) Polyploidy- Autopolyploidy and Allopolyploidy. Aneuploidy- Monosomy, Nullisomy and Trisomy. Structural - Deletions (Terminal, Interstitial), Duplication (Tandem, Reverse tandem and Displaced), Translocation (Simple, Isochrome, Reciprocal, Displaced) and Inversions (Pericentric and Paracentric). Significance of chromosomal aberrations.

**Unit V: Pedigree:** Symbols used in pedigree studies, Pedigree analysis and construction, Pedigree analysis for the inheritance pattern of genetic diseases, Genetic Counselling.

**Unit VI: Bacterial genetics:** Bacterial Genetics: Transformation, Transduction-Generalized and specialized; Conjugation: F factor mediated, Hfr and Sexduction. Transposable elements: Bacteria, Yeast, Maize and Drosophila.

**MBG2C06. Food and Dairy Microbiology**

**Unit 1:** Food as a substrate for microorganisms. Common microorganisms in food. Factors influencing microbial growth in food – intrinsic, extrinsic and implicit.

**Unit 2 : Fermented food products:** Food fermentations- Principles and classification. Starter, non-starter cultures in food fermentation. Fermentation of wine and beer. Fermented vegetables- sauerkraut, pickle, olives. Fermented cereals- bread, idli, dosa, koji. Fermented meat– sausage. Fermented fish products. Other fermented foods- Vinegar, soy sauce. Whey fermentation. SCP fermentation

**Unit 3: Dairy microbiology:** Physical and chemical properties of milk. Microbiological analysis of milk- DMC, SPC, MBRT, Resazurin test, Alkaline phosphatase test. Fermented Dairy products- Yoghurt, kefir, Acidophilus milk, buttermilk and cheese. Probiotics (*Lactobacillus*, *Bifidobacterium*) and prebiotics.

**Unit 4: Food spoilage and preservation:** General principles underlying food spoilage. Spoilage of meat, fish, egg, milk, vegetables, fruits and stored grains. Spoilage at low temperature. Spoilage of canned food. Principles of food preservation. Food preservation by physical methods- high and low temperature, drying, freezing, irradiation and high pressure. Food preservation by chemical methods- characteristics of food preservatives. Class I and class II preservatives. Modern food preservation techniques- high electronic field pulses, oscillating magnetic fields pulses, intense light pulses and ultra high hydrostatic pressure.

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**Unit 5: Food poisoning:** Food borne infections – Bacterial, Fungal and viral infections. Bacterial- *Salmonella, Staphylococcus, Listeria, Brucella, Bacillus, Clostridium, Escherichia*. Fungal – Aflatoxins and ergotism. Viral- Hepatitis, Bovine Spongiform encephalopathy.

**Unit 6: Food hygiene, regulation and standards:** Food sanitation. Food control agencies and their regulations. Codes for GMP. HACCP and FSO Systems for food safety.

**MBG2C07. Industrial Microbiology**

**Unit 1:** Isolation and screening of industrially important microbes. Strain selection and improvement. Bioprocesses- concepts and design. Continuous and batch fermentations. Types of bioreactors. Bioreactor design and control.

**Unit 2:** Kinetics of fermentation process. Transport phenomena in bioprocess such as mass transport coefficients for gases and liquids and oxygen transfer coefficients, heat transfer.

**Unit 3:** Principles of bioprocess media formulations. Sterilization systems. Concepts of inoculum development. Monitoring and control of variables such as temperature, agitation, pressure and pH.

**Unit 4:** Down stream processing – filtration, centrifugation, precipitation, salting out, crystallization and biphasic separation. Bioassays, Standardization, formulations and packaging. Shelf life consideration.

**Unit 5:** Manufacture of the following: penicillin, streptomycin, tetracycline, Vit. B -12. Citric acid by surface and submerged process. Ethanol fermentation from molasses. Industrial fermentation of wine and beer. Acetone - butanol fermentation. Bakers yeast. Lactic acid from whey, amylases by fungi, mono - sodium glutamate. Importance of fermentations in ayurvedic medicines. Importance and production of Single cell protein (SCP).

**Unit 6:** Industrial microbiological products as primary and secondary metabolites, regulation of overproduction of primary and secondary metabolites, bypassing of regulatory mechanisms for the over-production of primary and secondary metabolites.

**MBG2C08. Immunology**

**Unit 1:** Defense System: Immunity- Types and Detailed Mechanisms of Innate and Acquired Immunity. Vaccines. Antigens. Immunoglobulins- Structure, Classification and Biological Functions. Genetic Basis of Immunological Diversity. Monoclonal Antibodies and Hybridoma Technology

**Unit 2:** Lymphoid System: Lymphoid Cells. Hematopoiesis. Structure, Function, Maturation, Development and Classification of T and B Lymphocytes. Lymphocyte Traffic. Toll Like Receptors (TLR), Lymphoid Organs – Primary and Secondary. Cytokines- Types and Biological functions.

**Unit 3:** Immune Response: Humoral and Cell Mediated Immune Response. Primary and Secondary Immune Response. Processing and Presentation of Intracellular and Extracellular antigens. Immunological Tolerance and Theories of Immune Response. Major Histocompatibility Complex

**Unit 4:** Antigen-Antibody Reactions and their applications in immunodiagnosis. Complement System- Activation and Biological Functions. Structure of Membrane Attack Complex, Complement Fixation Test. Hypersensitivity- Types and Mechanisms.

**Unit 5:** Autoimmune Diseases-Causes, pathogenesis, diagnosis and treatment of common autoimmune diseases. Immunodeficiency Diseases, Transplantation Immunology-Types of Grafts, Grafts Acceptance & Mechanism of Graft Rejections. Host Versus Graft (HVG) and Graft Versus Host (GVH) Reactions, Prevention of Graft Rejections. Immunohematology- ABO and Rh Blood Group Systems, Blood Transfusion, Hemolytic Diseases, Rh Incompatibility. Tumor Immunology.

**MB2L03. Practical III**

**(Food and Dairy microbiology & Industrial microbiology)**

1. Milk microbiology - direct microscopic count and standard plate count, presumptive test for coliforms
2. Testing the quality of milk - Methylene blue reductase test, Resazurin test and alkaline phosphatase test.
3. Isolation of microbes from yoghurt, idli batter – bacterial and fungal
4. Brine storage of foods.
5. Whey fermentation to alcohol
6. Microbial spoilage of refrigerated food
7. Microbial analysis of food products – detection of indicator organisms ,faecal streptococci and *E.coli* by Most Probable Number method and direct plating.
8. Microbial analysis of food products – detection of pathogenic microorganisms, *S. aureus*, *Salmonella* and *Vibrio*.
9. Microbial analysis of food products – detection of anaerobic spore forming *Clostridia*
10. Microbial analysis of food products – detection of yeast and mould
11. Growth curve of bacteria using breeds count, CFU, turbidimetry and PCV
12. Demonstration of mutation in bacteria
13. Isolation of amylase producers.
14. Isolation of cellulase producers
15. Scale up of inoculum.
16. Cell disruption techniques
17. Downstream processing - Salting out
18. Immobilization of cell or enzyme
19. Bioassay of antibiotic.
20. Citric acid production by submerged fermentation.
21. Solid state fermentation
22. Production of wine.
23. Cultivation of mushroom.
24. Demonstration of IAA production



### **SEMESTER III**

#### **MBG3C09. Medical Microbiology**

Unit 1 : Bacteriology: Morphological characteristics, pathogenicity, epidemiology, laboratory diagnosis and treatment of following pathogenic bacteria. Morphological characteristics, pathogenicity, epidemiology, laboratory diagnosis and treatment of following pathogenic bacteria. Aerobic cocci- Staphylococcus, Streptococcus, Pneumococcus and Nesseria. Aerobic Gram positive bacilli- *Corynebacterium diphtheriae* and *Bacillus anthracis*. Anaerobic Gram positive bacilli – *Clostridium botulinum*. Gram negative bacilli – Enterobacteriaceae- *Escherichia coli*, *Proteus*, *Klebsiella*, *Shigella* and *Salmonella*. *Vibrio cholerae*. Spirochetes – *Treponema* and *Leptospira*. *Mycoplasma*. *Mycobacteria* – *M. tuberculosis* and *M. leprae* Miscellaneous bacteria- *Listeria*, *Campylobacter* and *Helicobacter*

Unit 2: Virology: Quantification and classification of viruses. Pathogenesis, laboratory diagnosis and prophylaxis of following viral infections –Polio, Influenza, Mumps, Measles, Rabies, Japanese encephalitis, Viral haemorrhagic fever, Rubella, Hepatitis, HIV, Slow virus diseases, Emerging viral diseases- bird flu, swine flu and Nippah.

Unit 3: Mycology and parasitology: Fungi – General characteristics, classification based on morphology and reproduction. Fungal diseases – Superficial (*Piedra* and *Pityriasis*), Cutaneous (*Dermatophytoses*), Subcutaneous (*Mycetoma*), Deep (*Histoplasmosis*) and Opportunistic fungal infection (*Candidiasis*). Protozoa – general features and classification. Morphology, lifecycle, pathogenesis and epidemiology of protozoan parasites – *Entamoeba histolytica*, *Giardia lamblia*, *Trypanosoma*, *Leishmania* and *Plasmodium*. Helminths – *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*.

Unit 4: Antibiotics- Classification of antibiotics based on the mode of action with one representative drug in each class- sulfonamides, quinolones, penicillins, cephalosporins, tetracyclines, aminoglycosides, macrolides. Brief outline of antifungal and antiviral drugs. Determination of MIC.

**MBG3C10- Molecular Biology**

**Unit-1:** DNA structure: Chemistry of DNA, Forces stabilizing DNA structure, Forms of DNA, Watson –Crick and Hoogsteen base pairing, Physical properties of ds DNA. Mechanisms of supercoiling in cells, Mechanism of action of Topoisomerase I and II, effect of supercoiling on structure of DNA and the role of supercoiling in gene expression. Organization of DNA into chromosomes: Eukaryotic chromosome organization and its molecular mechanism.

**Unit- 2:** DNA replication- Prokaryotic and eukaryotic DNA replication, mechanism of replication. Enzymes and necessary proteins in DNA replication. Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA Repair- Mismatch, Base-excision, Nucleotide-excision and direct repair DNA recombination- Homologous, site-specific and DNA transposition

**Unit-3:** Transcription- Prokaryotic and eukaryotic Transcription- RNA polymerases general and specific transcription factors- regulatory elements- mechanism of transcription regulation- Transcription termination. Post transcriptional modification- 5' cap formation-3' end processing and polyadenylation- splicing editing- nuclear export of mRNA- mRNA stability.

**Unit-4:** Translation: Structure and role of t-RNA in protein synthesis, ribosome structure, basic features of genetic code and its deciphering, wobble hypothesis, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes) Post translation modification by cleavage, self-assembly, assisted self-assembly chaperones, acylation, phosphorylation, acetylation and glycosylation, Histone acetylation and deacetylases, chromosome remodelling complex. Intein splicing. Protein targeting, co-translational import, post translational import, Lysosome targeting.

**Unit 5:** Molecular mechanism of gene regulation in prokaryotes-Transcriptional regulation in prokaryotes; Inducible & repressible system, positive and negative regulation; Operon concept, structure of operon, Lac, Trp, Ara operon, Catabolic repression, Attenuation. Role of Hormones in gene regulation. Antisense RNA, SiRNA, MicroRNA, Riboswitches & their applications.

**Unit 6:** Oncogenes & tumour suppressor genes, viral & cellular oncogenes, tumour suppressor genes from humans, pRb & p53 tumour suppressor protein.

### **MBG3E01. Diagnostic microbiology**

Unit 1. Automated Blood Cultures. Rapid Antigen Tests.- Advanced Antibody Detection.- Phenotypic Testing of Bacterial Antimicrobial Susceptibility.- Biochemical Profile-Based Microbial Identification Systems.

Unit 2. Probe-Based Microbial Detection and Identification.- Pulsed Field Gel Electrophoresis.- In Vitro Nucleic Acid Amplification: An Introduction.- PCR and It's Variations.- Non-Polymerase Chain Reaction Mediated Target Amplification Techniques.- Recent Advances in Probe Amplification Technologies.- Signal Amplification Techniques: bDNA, hybrid capture.

Unit 3. Detection and Characterization of Molecular Amplification Products: Agarose Gel Electrophoresis, Southern Blot Hybridization, Restriction Enzyme Digest Analysis and Enzyme-Linked Immunoassay.- Direct Nucleotide Sequencing for Amplification Product Identification.- Microarray-Based Microbial Identification and Characterization.- Diagnostic Microbiology Using Real-time PCR Based on FRET Technology.

Unit 4. Bacterial Identification Based on 16S Ribosomal RNA Gene Sequence Analysis. Advance in the Diagnosis of Mycobacterium tuberculosis and Detection of Drug Resistance. Molecular Strain Typing Using Repetitive Sequence –Based PCR.

### **MBG3E02. Cell Biology**

Unit 1- Introduction, Discovery of cell and Cell Theory. An overview of Cells – Composition of Cells Molecules of cell, cell membranes and cell Proteins. The Nucleus Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus.

Unit 2- Mitochondria, Chloroplasts and Peroxisomes Structural organization, Function, Marker enzymes, Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes' assembly

Unit 3- Cytoskeleton and Cell Movement Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules. Protein Sorting and

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Transport - The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes.

Unit 4. Signal transduction: electrical impulses and their transmission: Structure and electrical properties of neurons, resting potential, action potential, propagation of action potential, voltage gated and ligand gated channels, synaptic transmission, chemical signals and receptors, second messengers: cAMP, Ca ions, Ras pathway, glycogen breakdown by epinephrine. Nucleus, structure of chromosomes, chromosome banding, mitosis and meiosis, chromosomal organization Cell cycle: G1, S, G2, M phases, model organisms, MPF, cyclins, checkpoints, Role of Rb & p53. Cell cycle inhibitors

Unit 5. Cell death and cancer: Apoptosis and necrosis, apoptotic pathways, theories on apoptosis, types of tumor, induction of cancer, properties of cancer cells, oncogenes and onco genes, tumor suppressors, Molecular pathways- PIP3 Akt, MAP kinase.

**MBG3E03. Microbial Taxonomy**

Unit 1. Contributions of Pioneers in the field-Von Nageli, Chatton, Whittaker and Woese. Phylogenetic relationships. Brief outline of 5 kingdom classification. Three domain system-characteristics of the Domains: Bacteria, Archaea, Eukarya. Approaches in classification- Natural, Phenetic and Phylogenetic classification. Molecular or genetic approaches in classification. Numerical taxonomy.

Unit 2. Criteria used in classification-Morphological, cultural, biochemical, nutritional, ecological, serological characteristics. Principles and procedures of important tests (based on the characteristics) used in classification. Agglutination, Precipitation, ELISA, Western blotting, Phage typing, Fatty acid profile, Flow cytometry.

Unit 3. Molecular techniques: DNA base composition, DNA finger printing, Amino acid sequencing, PCR, Nucleic acid hybridisation, Southern blotting, DNA chips, Nucleic acid sequencing, Ribotyping and rRNA sequencing. Fluorescent In Situ Hybridisation (FISH).

Unit 4. Bergey's Manual of Systematic Bacteriology: Brief outline. Distinguishing features of Prokaryotes-Archaea and Bacteria. Characteristic features of the important groups under-Archaea: Crenarchaeota (Hyperthermophile) and Euarchaeota (Methanobacteriales and Halobacteriales). Bacteria: Proteobacteria (Alpha, Beta, Gamma, Delta and Epsilon),

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Nonproteobacteria (Deinococcus, Photosynthetic bacteria, Planctomycetes, Chlamydiae, Spirochetes and bacteroidetes), Gram positives -Low G+C gram positive bacteria (Firmicutes- Mycoplasma, Clostridia and Bacilli) and High G+C gram positive bacteria (Actinomycetes-Corynebacterium, Mycobacterium, Streptomyces).

**MBG3L04 Practical IV**

**(Immunology and Medical Microbiology)**

1. Acid fast staining
2. Preparation and microscopic examination of pathogenic microbes using permanent slides
3. Preparation of antibiotic discs
4. Determination of MIC
5. Demonstration of antifungal activity
6. Antibigrams of common bacterial pathogens by Kirby Bauer method
7. Detection of betalactamase production
8. Study of normal microbial flora of human beings
9. Identification of common bacterial pathogens from clinical specimen using morphological, cultural and biochemical characteristics.
10. Identification of common fungal pathogens from clinical specimen using morphological, cultural and biochemical characteristics.
11. Routes of viral inoculation in embryonated eggs
12. Blood group determination
13. Ouchterlony Double diffusion Test
14. Widal test: Slide and Tube tests
15. VDRL test
16. ELISA

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17. Immunoelectrophoresis
18. Blood cell count - TC and DC
19. ESR determination
20. Complement fixation test

**MBG3L05. Practical V**

**(Principles of Genetics & Molecular Biology)**

1. Study of mitotic stages using onion root tip
2. Meiosis
3. Agarose Gel Electrophoresis
4. DNA isolation, purification and visualization
5. Estimation of DNA
6. RNA isolation, purification and visualization
7. Estimation of RNA
8. Hyperchromic shift on DNA melting
9. Bacterial conjugation
10. Bacterial transformation
11. Isolation of plasmids
12. Induction of Beta galactosidase gene in E. coli
13. Cloning in E.coli
14. Restriction Enzyme digestion of DNA

## SEMESTER 4

### MBG4C11. Biostatistics and Bioinformatics

Unit 1. Biostatistics – Principles and practice of statistical methods in Biological Research; Basic statistics; Averages; statistics of Dispersion; Coefficient of variations; Standard error; Probability; Distributions; Tests of statistical significance; Students T-test; Basics of correlation and regression. Analysis of variance.

Unit -2 Introduction to Bioinformatics and Biological Databases: Biological databases - nucleic acid, genome, protein sequence -Uniprot-KB: SWISS-PROT, TrEMBL, gene expression databases. Mode of data storage - File formats - FASTA, Genbank and Uniprot. Various file formats for biomolecular sequences: GenBank, FASTA. Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.

Unit 3- Sequence Alignments, Phylogeny and Phylogenetic trees :Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction-UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood.

Unit 4:- Molecular docking-types of docking-types of interaction-search algorithm, scoring function-key stages of docking-autodock -application-Drug designing. Structure prediction and protein modelling.

### MBG4E04. Microbial Biotechnology

Unit 1. Production of microbial biofertilizers – cyanobacteria, *Rhizobium*, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and VAM. Extremophiles and their possible uses - Thermophilic organisms. Yeasts and its uses - Brewer's and Baker's yeast - Food and fodder yeasts - yeast products and their uses. Microbes as a health food - Spirulina and its production methods.

Unit 2. Petroleum microbiology - Sedimental microbes in petroleum formation - Coal bioprocess to eliminate sulphur. Microbial enhanced oil recovery, oil spills degradation by

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microorganisms. Microbial production of fuels- H<sub>2</sub> and ethanol. Microbial leaching of ores - oil extraction - metal leaching and biomining. Microbes and bioremediation - role of microbes in herbicides, pesticides and other xenobiotics degradation. Degradation of toxic chemicals by *Pseudomonas*. Biotransformation - useful products obtained in biotransformation. Microbial production of products like Biopolymers and biosurfactants.

Unit 3. Immobilization of cells and enzymes. Advantages and disadvantages of immobilized systems. Enzyme based electrodes. ATPase based cell quantitation and Lumac system. Hybridoma technology for monoclonal antibodies, recombinant vaccines, Animal cell culture. Novel bioreactor designs for animal cell culture – hollow fiber, microcarrier and spin bioreactors. Probiotics - use of *Lactobacilli* and *Bifidobacterium* - therapeutic and nutritional value.

Unit 4. Microbial Insecticides, Commercial Products by Recombinant Microbes, Plant and animal Transgenesis, Cloning, Gene Therapy. Vaccine farming. Environmental impact of genetic engineering – problems of GM foods and crops, Bti. Toxin resistance of insects - cotton bollworm, tobacco budworm, use of multiple alleles of Bti toxin genes. Environmental release and monitoring of genetically modified/engineered organisms. Milk flavor manipulation through rumen microflora, mitigating greenhouse gas emission from dairying using biotechnology.

### **MBG4E05. Genetic engineering**

Unit 1. Restriction digestion of DNA, separation by isopycnic & agarose gel methods. Cloning vectors-plasmids, BACs, PACs & YACs, cutting & joining DNA molecules, linkers, adaptors & homopolymer tailing, DNA libraries- construction of DNA libraries, genomic & cDNA libraries,

Unit 2. PCR-different types like RT-PCR, long PCR, inverse PCR, quantitative PCR, differential display PCR, nested PCR, RACE etc., probes- radiolabel led DNA/RNA probes, synthetic oligonucleotide probes, cloning strategies-cloning in E.coli, yeast & gram +ve bacteria.



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Unit 3. Expression strategies for heterologous genes, vector engineering & codon optimization, screening strategies, screening by hybridization, colony hybridization, plaque lift assay, Northern, southern & western blotting, FISH, reporter assays. (25 Marks)

Unit 4. DNA sequencing, nucleic acid microarrays, site directed mutagenesis & protein engineering, DNA introduction methods like calcium chloride facilitated uptake, microinjection, electroporation, particle bombardment, use of Ti plasmid in generating transgenic plants. Molecular markers in genome analysis: RFLP, RAPD, AFLP analysis. RNA interference. (15 Marks)

**MBG4E06. Biosafety, Bioethics & IPR**

Unit 1. Impacts of biotechnology – legal, socioeconomic, public elucidation of process of biotechnology in generating new forms of life. Biosafety in general, Food and feed products containing GMOs, Risk assessment/analysis, Risk management, Ethical aspects of GMOs, policy on the storage of GMOs, Gene technology act, Precautionary principle, Potential environmental risks & benefits, Potential socio-economical risks & benefits.

Unit 2. Bioethics: The Nature of Bioethics, Genetic modification/research on plants and animals, therapeutic cloning, human cloning, stem cell research. Federal Laws and the roles of: The Food and Drug Administration, The Centers for Disease Control and Prevention, The United States Department of Agriculture, The Environmental Protection Agency, State and Local Agencies

Unit 3. Patenting research tools and the law: Patents as a Strategy for Protection of Intellectual Property, Benefits and Costs of Patents, Requirements for Patent Protection, patentable subjects and protection in biotechnology, international convention for the protection of new varieties – Strasbourg convention, UPOV convention. Experimental Use Exemption. The patentability of microorganisms, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology. Patentability of vectors.

Unit 4. Patents on Research Tools. Access to data and intellectual property: scientific exchange in genome research. Patented research tools - Recombinant DNA, PCR, Taq Polymerase, Protein and DNA Sequencing Instruments, Research Tools in Drug Discovery.

**MBG4L06. Practical VI**

**(Biostatistics and Bioinformatics)**

1. Biological Databanks- Sequence Databases, Structure Databases, Specialized Databases
2. Introduction to National Center for Biotechnology Information (NCBI)
3. Data retrieval: Entrez, SRS and DBGet.
4. Analysis of gene sequence from nucleotide database.
5. Analysis of protein sequence from protein database.
6. Introduction to PDB and analysis of PDB file.
7. Molecular visualization
8. Gene structure and function prediction (using GenScan, GeneMark)
9. Sequence similarity searching using BLAST and interpretation of the results.
10. Multiple sequence alignment using Clustal and interpretation of the results.
11. Protein sequence analysis using ExpASy proteomics tools
12. Phylogenetic analysis using web tools
13. Phylogenetic analysis using PHYLIP
14. Sequence analysis using EMBOSS
15. Homology Modeling and structure refinement Swiss model
16. Model validation using What Check and Pro Check
17. Docking using HEX
18. Biostatistics problems
19. Statistical Analysis using EXCEL: graphical presentation
20. Regression Analysis using spreadsheet application

**MBG4P. Dissertation**

A dissertation should be submitted by each student as a part of the curriculum, based on a topic related to the subject area at the end of the fourth semester.

**REFERENCES**

1. A hand book of water and waste water microbiology – Mara & Nigel Horan
2. A text book of Medical Mycology-J. Chander
3. Advanced Techniques in Diagnostic Microbiology -Tang, Yi-Wei; Stratton, Charles W. (Eds.)2006.
4. Agricultural Microbiology – Rangaswami
5. Agricultural Microbiology – Subha rao
6. Bailey and Scott’s Diagnostic microbiology – Baron *et al*
7. Basic food microbiology – Banwart GJ
8. Biochemistry – DM Vasudevan and S Sreekumari
9. Biochemistry – Strayer
10. Biochemistry – Voet and Voet
11. Biochemistry – West and Todd
12. Bioethics: An Introduction for the Biosciences - Ben Mepham,
13. Bioinformatics - sequence and genome analysis – Mount
14. Bioinformatics computing – Bergeron
15. Biological fundamentals – Biotechnology – Ed. H.J. Rehm and G. Reid
16. Biopesticides, use and delivery – Hall and Menn
17. Biostatistical analysis - Zar
18. Biotechnology – B.D. Singh
19. Biotechnology of Integrated pest management – Persley
20. Cell & Molecular Biology-Gerald Karp.
21. Comprehensive biotechnology – Murray and Moo Yung
22. Dairy Microbiology – Robinson RK
23. Diagnostic methods in Clinical Virology : N.R. Grist
24. Environmental Biotechnology – Principles and applications –Burce E *et al.*,
25. Environmental biotechnology and cleaner bioprocess
26. Essential Clinical immunology – Helen Chappell and Mansei Haemy
27. Essentials of Diagnostic Virology: G. Storch
28. Food microbiology – Adams MR and Moss MO
29. Food Microbiology – Frazier WC and Westhoff
30. Food Microbiology -Doyle *et al.*

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31. Fundamental immunology – Paul W. E *et al*
32. Fundamental principles of bacteriology – A.J. Salle
33. Fundamentals of biotechnology – Ed. Paul Prave *et al.*,
34. Fundamentals of Immunology – Kuby
35. Fundamentals of microbiology – Frobisher
36. Fundamentals of Molecular Virology By Nicholas H. Acheson
37. Fundamentals of the Fungi- Moore
38. Fungal infections: Diagnosis and Management- Richardson and Warnock.
39. General Microbiology – Stanier
40. Genes VIII – Benjamin Lewin
41. Immunobiology – Janeway Travers
42. Immunology – Coleman *et al*
43. Immunology – Roitt
44. Industrial microbiology – Prescott and Dunns
45. Introduction to Bioinformatics – Arthur M Lesk
46. Introduction to immunology – John W Kimbal *et al.*,
47. Lehninger's Principles of Biochemistry – Nelson and Cox
48. Manuel of Industrial microbiology and biotechnology – Demain & Davies
49. Medical Microbiology - Macie and Mc. Cartney
50. Medical Microbiology : David Greenwood, Slack, Peutherer
51. Medical Mycology- Rippon
52. Medical Virology : Fenner and White
53. Microbial Ecology - Ronald M Atlas
54. Microbial genetics - Maloy, S.R., J.E., Cronana and D. Friedfelder. 1994.
55. Microbiology – Pelzar M.J, Chan *et al.*,
56. Microbiology – Prescott
57. Microbiological Applications – Alfred E Brown
58. Molecular Biology – Friefelder
59. Molecular biology of the cell – Bruce Alberts *et al.*,
60. Molecular Biology of the Gene – Watson
61. Molecular Biotechnology- Glick & Pasternac
62. Molecular Cell Biology – Lodish
63. Notes on Medical Virology By Morag. C. Timbury

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64. Plant breeding – B.D. Singh
65. Plants, genes and crop biotechnology – Chrispels & Sadava
66. Principles and Practice of Infectious diseases – Madell, Bennett, Dolin Vol-1 & 2
67. Principles of Biochemistry – White Handler and Smith
68. Principles of Fermentation technology – Stanburry PF, Whitekar
69. Principles of Gene Manipulation – Primrose
70. Principles of Microbiology – Ronald M Atlas
71. Recombinant DNA technology -Watson
72. Text book of Biotechnology – Cruger and Cruger
73. Text book of Medical Parasitology-CKJ Panicker.
74. Text book of Microbiology – Jayaram Paniker and Ananthanarayanan

**M.Sc. Microbiology (CBCSS)**  
**Ability Enhancement Course (AEC)**

4 Credits

**Recommended courses – Publications/ Book review/Seminar presentation**

**Theoretical knowledge required**

Academic writing in science - Types of research papers, structure of research paper, reading a research paper and basics of writing a research paper

Language aspects of research paper, revising the paper, responding to peer reviews etc.

Ethical aspects of research writing, plagiarism.

**Evaluation method**

Theoretical knowledge assessed through written test
Paper published in UGC approved peer reviewed journals/Book reviews submitted by the student in the concerned subject area/seminar paper/poster presentation in state level/national/international seminars based on original works.

**Professional Competency Course (PCC)**

4 credits

**Practical knowledge required**

Application of different softwares such as SPSS/Design expert/ or any statistical software.

Data analysis and graph preparation.

Application of bibliography management softwares such as mendley and zotero.

Systematically searching the literature for systematic reviews, Evidence Based Case Reports etc.

Preparing effective presentations, power point/impress etc.

**Evaluation method**

Practical knowledge assessed performance test



UNIVERSITY OF CALICUT

**Abstract**

General and Academic - Choice Based Credit Semester System PG - CBCSS PG Regulations 2019 - Regulations for Post-Graduate Programmes of affiliated Colleges and SDE/ Private Registration w.e.f. 2019 admissions- Amendment and Modifications - Implemented - Orders Issued.

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**G & A - IV - J**

U.O.No. 15132/2019/Admn

Dated, Calicut University.P.O, 28.10.2019

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*Read:-*1) U.O.No. 4487/2019/Admn dated 26.03.2019

- 2) Item No.I &II in the minutes of the meeting of the Academic Committee on CBCSS PG Regulations 2019 held on 27.08.2019
- 3) Item No.II in the minutes of the meeting of the Academic Committee on CBCSS PG Regulations 2019 held on 27.09.2019
- 4) Item No.I.9 & I.28 in minutes of the meeting of the LXXX Academic Council held on 05.10.2019.

**ORDER**

The Regulations for Choice Based Credit and Semester System for Post Graduate (PG) Curriculum 2019 (CBCSS PG Regulations 2019) for all PG Programmes of affiliated Colleges and SDE/ Private Registration under University of Calicut, w.e.f. 2019 admissions has been implemented vide paper read as (1).

The Academic Committee on CBCSS PG Regulations 2019, vide paper read as (2), recommended the following modifications in CBCSS PG Regulations 2019:

1. Clauses 6.4,6.4 (i), 6.4 (ii), 6.8 & 6.10 (in the column of credit) shall be modified adding the condition "except for MSW Programme"
2. Clause 6.4 (iiD, 6.4 (iv) & Clause 6.4 (v) shall be deleted.
3. Clause 6.10- The following conditions in the column of credit shall be deleted.
  - (a) "Minimum credit for one course shall not be less than 2 and shall not exceed 5"
  - (b) "The maximum credit for comprehensive viva-voce and project work combined together shall be subject to a minimum credit of 4 for Project work."
4. Clause 6.10- The following condition in the column of Total Credit shall be deleted: "Vary from 18 to 22 in each semester"
5. Clause 7.5 shall be deleted.
6. Clause 14.1- the condition "shall be equal as far as possible" shall be deleted.

The Academic Committee on CBCSS PG Regulations 2019, vide paper read as (3), recommended the following modifications in CBCSS PG Regulations 2019:

- a) Recommended to delete Clause 19.3 (There shall not be any comprehensive viva-voce for SDE students).
- b) Clause 7.3 shall be modified as follows: "SDE/Private Registration students have no Project work. They have to undergo one Theory Course, framed by Board of Studies concerned. Comprehensive Viva-Voce is compulsory."

Academic Council, vide paper read as (4) approved the above recommendations of Academic Committee on CBCSS PG Regulations 2019 and the Vice Chancellor has accorded sanction to implement the resolutions of Academic Council.

Sanction is therefore accorded for implementing the modifications referred vide paper read as (2) & (3) above in CBCSS PG Regulations 2019 w.e.f 2019 admission onwards.

Orders are issued accordingly. U.O.No. 4487/2019/Admn dated 26.03.2019 stands modified to this extent.

(Regulations appended)

Biju George K

Assistant Registrar

To

1.The Controller of Examinations 2.Director, SDE

Copy to: PS to VC/ PA to PVC/ PA to Registrar/ PA to CE/ JCE V/GA IV-B,E,J Sections/System Administrator/ Enquiry/ SF/DF/FC

Forwarded / By Order

Section Officer





# **UNIVERSITY OF CALICUT**

## **CHOICE BASED CREDIT SEMESTER SYSTEM-PG (CBCSS PG - 2019)**

### **REGULATIONS FOR THE PG PROGRAMMES OF AFFILIATED COLLEGES & SDE / PRIVATE REGISTRATION**

**Regulations for the Post-Graduate Choice Based  
Credit Semester System - 2019**

**1. SHORT TITLE**

These regulations shall be called “**Regulations for Choice Based Credit Semester System for Post-Graduate Curriculum - 2019 for affiliated Colleges and for SDE / Private Registration**” (CBCSS-PG) 2019.

**2. SCOPE, APPLICATION & COMMENCEMENT**

- 2.1 The regulations provided herein shall apply to all the regular Post Graduate programmes offered by the affiliated colleges (Government/Aided/Unaided/Self-financing) of the University of Calicut, Autonomous Colleges and all the Post Graduate programmes offered by the School of Distance Education / Private Registration with effect from the 2019 batch admission.
- 2.2 However in matters connected to the setting of question papers, conduct of examinations and other matters related to examinations, the Autonomous colleges can draft their own guidelines subject to the approval of the University.
- 2.3 However, these regulations are not applicable to the regular PG programmes offered by the Teaching Departments/Schools of the University and M.P.Ed, M.Ed, MBA and LLM Programmes which are governed by separate regulations.
- 2.4 These regulations shall supersede all the previous regulations for the regular Post-graduate programmes offered through the affiliated colleges, the School of Distance Education or the Private Registration window of the University unless otherwise specified.

**3. DEFINITIONS**

- 3.1 ‘**Academic Committee**’ means the Committee constituted by the Vice-Chancellor under this regulation to manage and monitor the running of the Post Graduate programmes, under CBCSSPG-2019.
- 3.2 ‘**Programme**’ means the entire course of study and Examinations (traditionally referred to as course).
- 3.3 ‘**Duration of Programme**’ means the period of time required for the conduct of the programme. The duration of post-graduate programme shall be four semesters.
- 3.4 ‘**Semester**’ means a term consisting of a minimum of 90 working days including examination days distributed over a minimum of 18 weeks each of 5 working days.
- 3.5 ‘**Course**’ means a segment of the subject matter to be covered in a semester (traditionally referred to as paper). All the courses need not carry the same weightage. The courses should define their learning objectives and learning outcomes. A course may be designed in such a way that it consists of lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.
- 3.6 ‘**Core course**’ means a compulsory course in a subject related to a particular PG Programme, which shall be successfully completed by a student to receive the degree.

- 3.7 'Elective course'** means a course, which can be substituted, by equivalent course from the same subject and a minimum number of courses are required to complete the programme.
- 3.8 Audit Course** :These courses are mandatory for which the student can register without earning credits.
- 3.9 Ability Enhancement Course** : This is one among the Audit courses which is mandatory for all programmes but not counted for the calculation of SGPA or CGPA. The object is to enhance the ability and skill in the concerned core area.
- 3.10 Professional competency Course** :This is one among the Audit courses which is mandatory for a programme but not counted for the calculation of SGPA or CGPA. The object is to get professional competency and exposure in the concerned core area.
- 3.11 'Readmission'** is the act of admitting a student again after leaving the institution.
- 3.12 'Improvement course'** is a course registered by a student for improving his/her performance in that particular course.
- 3.13 'Department'** means any teaching Department offering a course of study approved by the University in a college or SDE/Private Registration as per the Statute and Act of the University.
- 3.14 'Parent Department'** means the Department (or SDE/Private Registration) which offers a particular postgraduate programme.
- 3.15 'Department Council'** means the body of all teachers of a Department in a College.
- 3.16 'Department Coordinator'** is a teacher nominated by Department Council to coordinate the continuous evaluation undertaken in that Department.
- 3.17 'Student Advisor'** means a teacher/coordinator from the college nominated by the College Council / to look into the matters relating to CBSSPG-2019.
- 3.18 'Credit' (C)** of a course is a measure of the weekly unit of work assigned for that course.
- 3.19 'Letter Grade'** or simply '**Grade**' in a course is a letter symbol (e.g., A+,A,B+,B, etc (as mentioned in Clause 20.2 of this Regulation) which indicates a particular range of grade points which indicates the broad level performance of a student.
- 3.20 Grade Point (G)** :It is a numerical weightage allotted to each letter grade on a Grading Scale.
- 3.21 'Credit point' (P)** of a course is the value obtained by multiplying the grade point (G) by the Credit (C) of the course  $P=G \times C$ .
- 3.22 'Semester Grade point average' (SGPA)** is the value obtained by dividing the sum of credit points obtained by a student in various courses taken in a semester by the total number of credits taken by him/her in that semester. The grade points shall be rounded off to two decimal places.

**3.23 'Cumulative Grade point average' (CGPA)** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

**3.24 SDE** means School of Distance Education.

**3.25** Words and expressions used and not defined in these regulations but defined in the Calicut University Act and Statutes shall have the meaning assigned to them in the Act and Statute.

#### **4. DURATION OF THE PROGRAMME**

**4.1** The minimum duration for completion of a four semester PG Programme is **two years**. The maximum period for completion is 4 years.

**4.2** The duration of each semester shall be 90 working days, inclusive of examinations, spread over five months.

**4.3** Odd semesters shall be held from June to October and even semesters from November to March subject the academic calendar of the University.

#### **5. SCHEME AND SYLLABUS**

**5.1** The detailed scheme and syllabus for each course shall be framed by the Board of Studies concerned and approved by the faculties concerned and Academic Council based on this Common Regulation.

#### **6. PROGRAMME STRUCTURE**

**6.1** Students shall be admitted to post graduate programme offered under any of the faculties of the University.

**6.2** The programme shall include three types of courses : **Core courses, Elective courses and Audit Courses**.

**6.3** Comprehensive Viva-voce and Project Work / Dissertation shall be treated as Core Courses. Project Work is mandatory for all regular programmes and Comprehensive Viva-voce is optional and these shall be done in the end semester. For SDE / Private Registration students both the Project Work and Comprehensive Viva-voce is optional instead they can have two additional theory courses as per the stipulations of the concerned BoS.

**6.4** Total credit for the programme shall be 80 (eighty), except for MSW Programme, this describes the weightage of the course concerned and the pattern of distribution is as detailed below :

- i) Total Credit for Core Courses shall not be less than 60 (sixty) and not more than 68 (sixty eight), except for MSW Programme.
- ii) Total Credit for Elective Course shall not be less than 12 (twelve) and not more than 20 (Twenty), except for MSW Programme.
- iii) *Deleted.*

iv) Deleted.

v) Deleted.

**6.5** Elective courses shall be spread over either in the Third & Fourth Semesters combined or in any one of these Semesters (III / IV) only subject to the stipulations of the BoS concerned.

**6.6** Study Tour / Field visit / Industrial visit / Trip for specimen collection may be conducted as a part of the Programme as per the stipulations of the BoS concerned.

**6.7 Audit Courses :** In addition to the above courses there will be two Audit Courses (**Ability Enhancement Course & Professional Competency Course**) with 4 credits each. These have to be done one each in the first two semesters. The credits will not be counted for evaluating the overall SGPA & CGPA. The colleges shall conduct examination for these courses and have to intimate /upload the results of the same to the University on the stipulated date during the III Semester. Students have to obtain only minimum pass requirements in the Audit Courses. The details of Audit courses are given below.

Semester	Course Title	Suggested Area	Details
I	Ability Enhancement Course (AEC)	Internship / Seminar presentation / Publications / Case study analysis / Industrial or Practical Training /Community linkage programme / Book reviews etc.	Concerned BoS can design appropriate AEC & PCC and evaluation criteria by considering the relevant aspects in the core area of the faculty under study.
II	Professional Competency Course (PCC)	To test the skill level of students like testing the application level of different softwares such as SPSS/R/ Econometrics / Pythan/Any software relevant to the programme of study / Translations etc.	

**6.8** The required number of credits as specified in the syllabus/regulations must be acquired by the student to qualify for the degree. A student shall accumulate a minimum of **80** credits for the successful completion of the programmes. (Except for MSW Programme)

**6.9** For uniform identification a common guideline for Coding various courses are given in the last part of the Appendix.

**6.10** Courses and Credit distribution summary :

<b>S e m e s t e r</b>	<b>Course</b>	<b>Teaching Hours</b>	<b>Credit</b>	<b>Total Credit</b>
<i>I</i>	Core Courses (Theory/Practical)			
<i>II</i>	Core Courses (Theory/Practical)			
<i>III</i>	(i) Core Courses (Theory/Practical) (ii) Elective Courses (Theory/Practical)			
<i>IV</i>	(i) Core Courses (Theory / Practical) Including : (a) Comprehensive Viva-voce (Optional) (b) Project Work / Dissertation (ii) Elective Courses (Theory/ Practical)			
<b>Total credit shall be</b>				<b>80</b>

I	<b>Audit Course I :</b> Ability Enhancement Course (AEC)	Not coming in the normal work load	4 (Not added for SGPA / CGPA)	4
II	<b>Audit Course II :</b> Professional Competency Course (PCC)		4 (Not added for SGPA / CGPA)	4

## 7. PROJECT WORK / DISSERTATION & COMPREHENSIVE VIVA-VOCE

- 7.1 There shall be a **Project work** with dissertation and **Comprehensive Viva-voce** as separate courses relating to the core area under study in the end Semester and included in the Core Courses.
- 7.2 For Regular students, **Project work is mandatory** for all faculties but **Comprehensive Viva-voce is optional**. Viva-voce related to Project work shall be one of the criteria for Project Work evaluation provided as per 18.6 of this regulation.
- 7.3 SDE/Private Registration students have no Project Work. They have to undergo one Theory Course framed by Board of Studies concerned. Comprehensive Viva-Voce is Compulsory.
- 7.4 If the SDE/Private registration students opt Project Work, it can be done only under the supervision of a working /retired teacher from a Govt /Aided College or a University teacher and prior approval/sanction from the SDE has to be obtained as per the stipulations of the concerned programme curriculum.
- 7.5 *Deleted.*
- 7.6 All students have to submit a Project Report/Dissertation in the prescribed structure and format as a part of the Project Work undertaken as per the stipulations of the concerned BoS.
- 7.7 There shall be **External and Internal evaluation for Project Work** and these shall be combined in the proportion of 4:1. In the case of Comprehensive Viva-voce, the conduct of **External Viva-voce is mandatory** but internal is optional, subject to the decision and stipulations of the BoS concerned.
- 7.8 Detailed course structure on Project work to be done, Viva-voce and Project Report preparation can be designed by integrating relevant aspects by the concerned Board of Studies of the Programme.
- 7.9 Details of evaluation of Project Work/Dissertation and Comprehensive Viva-voce are given under clause 18 of this regulation.

## 8. BOARD OF STUDIES AND COURSES

- 8.1 The PG Boards of Studies concerned shall design all the courses offered in the post-graduate programmes. The Boards shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified/re-designed courses to facilitate better exposure and training for the students.

- 8.2** **The Syllabus** of a course shall include course code, the title of the course, the number of credits, maximum grade for external and internal evaluation, duration of examination hours, distribution of internal grade, model question paper and reference materials. The Board of Studies concerned has the liberty to decide whether the questions can be answered in Malayalam or not. Maximum efforts shall be made to maintain a uniform pattern while designing the courses, project, viva, practical etc. in the scheme and syllabus of various programmes coming under same faculty.
- 8.3** Code numbers for the courses can be given as per the general guidelines given in the 'Appendix' for a uniform identification.

## **9. ADMISSION**

- 9.1** The admission to all PG programmes shall be as per the rules and regulations of the University.
- 9.2** The eligibility criteria for admission shall be as announced by the University from time to time.
- 9.3** Separate rank lists shall be drawn up for reserved seats as per the existing rules.
- 9.4** The college shall make available to all the admitted students the information regarding all the courses including electives offered with syllabus and credit for the entire course.
- 9.5** There shall be a uniform calendar prepared by the University for the Conduct of the programmes.
- 9.6** There shall be provision for inter collegiate and inter University transfer in the 2<sup>nd</sup> and 3<sup>rd</sup> semester within a period of two weeks from the date of commencement of the semesters.
- 9.7** There shall be provision for credit transfer subject to the conditions specified by the Board of Studies concerned.
- 9.8** The SDE shall make available to all students admitted in SDE/Private Registration mode, a Handbook containing the details of the courses offered indicating Core courses, Elective courses, Audit Courses, respective credits, procedures of the Project work to be done and other relevant aspects of the Programme in order to get a clear idea about the programme under study.
- 9.9** There shall be provision for transfer from Regular stream to SDE/Private registration and SDE/Private Registration to Regular (under the same scheme and syllabus) in the Second and Third Semester within a period of two weeks or the period fixed by the University from the date of commencement of the academic year as per the existing rules and regulations for inter college transfer. Transfer of students from Autonomous colleges to SDE and SDE to Autonomous Colleges is also permitted.
- 9.10** There shall be a uniform **calendar** prepared by the University for the registration, conduct/schedule of the courses, examinations and publication of results. The University shall ensure that the calendar is strictly followed.

## **10. READMISSION**

- 10.1** There shall be provision for readmission of students.
- 10.2** For readmission, the vacancy should be within the sanctioned strength in the parent college. If there is no vacancy in the junior batch of the parent college, readmission can be taken in another college with the junior batch, if there is vacancy within the sanctioned strength in the concerned college.
- 10.3** This readmission is not to be treated as college transfer.



- 10.4** There should be a gap of at least one semester for readmission.
- 10.5** The candidate seeking readmission to a particular semester should have registered for the previous semester examination.
- 10.6** Readmission shall be taken within two weeks from the date of commencement of the semester concerned.
- 10.7** The Principal can grant readmission to the student, subject to the above conditions, and inform the matter of readmission to the Controller of Examinations within one month of such readmission.
- 10.8** If change in scheme occurs while readmission, provision for credit transfer will be subject to the common guidelines prepared by Board of Studies/ Faculty concerned.
- 10.9** This provision is applicable to SDE/Private Registration student also irrespective of vacancy and sanctioned strength.

## **11. REGISTRATION**

- 11.1** - A student shall be permitted to register for a programme at the time of admission.
- 11.2** - A student who registers for a programme shall complete it within 4 years.
- 11.3** - The college shall send a list of students registered for each programme in each semester giving the details of courses registered to the university in the prescribed form within 45 days of the commencement of the semester.
- 11.4** - Students shall be normally permitted to register for the examination if they have required minimum attendance as per clause 12 of this regulation. If the student has a shortage of attendance in a semester, the student shall be permitted to move to the next semester and can write the examination for the entire courses of the semester in which shortage of attendance occurs as supplementary examination only after the completion of the entire programme. In such cases, a request from the student may be forwarded through the Principal of the college to the Controller of Examinations within two weeks of the commencement of the semester. There will not be any Repeat semester in CBCSSPG 2019.
- 11.5** - The students who have attendance within the limit prescribed as per clause 12 of this regulation, but could not register for the semester examinations, have to apply for token registration, within two weeks of the commencement of the next semester.

## **12. ATTENDANCE**

- 12.1** - The students admitted in the PG programmes in affiliated colleges shall be required to attend at least 75 percent of the total number of classes (theory/practical) held during each semester. The students having less than prescribed percentage of attendance shall not be allowed to appear for the University examination.
- 12.2** - For SDE / Private Registration students, minimum 75% of attendance is required for the courses having mandatory Contact classes insisted by the Programme.
- 12.3** - Condonation of shortage of attendance for a maximum of 9 days (10% of the working days in a semester) in the case of single condonation and 18 days (20% of the working days in a semester) in the case of double condonation in a semester subject to a maximum of two times (for single condonation only) during the whole period of Post Graduate programme may be granted by the University as per the existing procedures. In the case of double condonation, only one condonation shall be allowed during the entire programme.
- 12.4** - Benefit of condonation of attendance will be granted to the students on health grounds, for participating in University Union activities, meeting of the University bodies /Govt. bodies and participation in other extracurricular activities on production of genuine supporting documents, with the recommendation of the Head of the Department concerned.

**12.5** - A student who is not eligible for such condonation **shall be observed the provisions as per clause 11.4** of this regulation. The principal should intimate the details of these candidates at the commencement of the next semester.

**12.6** - Women students can avail maternity leave as per the existing university rules.

### **13. EXAMINATION**

**13.1** - There shall be University examination at the end of each semester.

**13.2** - Practical examinations shall be conducted by the University at the end of each semester or at the end of even semesters as prescribed in the curriculum of the particular Programme. The number of examiners and other aspects of the practical examination shall be prescribed by the concerned Boards of Studies of the programmes.

**13.3 - Project Work / Dissertation** shall be evaluated at the end of the programme only. There shall be both Internal and External evaluation for the Project Work. The details of internal evaluation shall be framed by the concerned Boards of Studies.

**13.4 - Comprehensive Viva-Voce** shall be conducted at the end of the programme only. There shall be only External Comprehensive Viva-Voce conducted by the examiners appointed by the University. The details of evaluation shall be framed by the concerned Boards of Studies.

**13.5** - There shall be one end-semester examination of 3 hours duration for each theory course and the duration of practical course can be decided by the concerned BoS.

### **14. SCHEME AND SYLLABUS**

**14.1** - Distribution of courses/weightage for theory/practical among the semesters and the aggregate weightage for each semester shall be stipulated by the Boards of studies concerned.

**14.2** - The detailed scheme and syllabus for each course shall be framed by the respective Boards of Studies concerned and approved by the faculty concerned and Academic Council.

### **15. EVALUATION AND GRADING**

**15.1 Evaluation:** The evaluation scheme for each course shall contain two parts; (a) Internal / Continuous Assessment (CA) and (b) External / End Semester Evaluation (ESE).

**15.2** Of the total, 20% weightage shall be given to Internal evaluation / Continuous assessment and the remaining 80% to External/ESE and the ratio and weightage between Internal and External is **1:4**.

**15.3** Primary evaluation for Internal and External shall be based on 6 letter grades (**A+, A, B, C, D and E**) with numerical values (Grade Points) of **5, 4, 3, 2, 1 & 0** respectively.

**15.4 Grade Point Average:** Internal and External components are separately graded and the combined grade point with weightage **1** for Internal and **4** for external shall be applied to calculate the **Grade Point Average (GPA)** of each course. Letter grade shall be assigned to each course based on the categorization based on Ten point Scale provided in clause **20.2** of this regulation.

**15.5 Evaluation of Audit Courses:** The examination and evaluation shall be conducted by the college itself either in the normal structure or MCQ model from the Question Bank and other guidelines provided by the University/BoS. The Question paper shall be for minimum 20 weightage and a minimum of 2 hour duration for the examination. The result has to be intimated / uploaded to the University during the Third Semester as per the notification of the University.

## 16. INTERNAL EVALUATION / CONTINUOUS ASSESSMENT (CA)

**16.1** This assessment shall be based on a predetermined transparent system involving periodic written tests, assignments, seminars and viva-voce in respect of theory courses and based on tests, lab skill and records/viva in respect of practical courses.

**16.2** The criteria and percentage of weightage assigned to various components for internal evaluation are as follows :

<b>(a) Theory :</b>			
Sl.No	Component	Percentage	Weightage
1	Examination /Test	40%	2
2	Seminars / Presentation	20%	1
3	Assignment	20%	1
4	Attendance	20%	1
<b>(b) Practical :</b>			
1	Lab Skill	40%	4
2	Records/viva	30%	3
3	Practical Test	30%	3

*(The components and the weightage of the components of the practical (Internal) can be modified by the concerned BOS without changing the total weightage 10.)*

**16.3** Grades shall be given for the internal evaluation are based on the grades A+,A,B,C,D&E with grade points 5,4,3,2, 1 &0 respectively. The overall grades shall be as per the Ten Point scale provided in clause **20.2** of this regulation.

**16.4** There shall be no separate minimum Grade Point for internal evaluation.

**16.5** To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board before 5 days of commencement of external examination.

**16.6** There shall not be any chance for improvement of internal marks.

**16.7** The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the University, through the college Principal, after being endorsed by the Head of the Department.

**16.8** For each course there shall be class **test/s** during a semester. Grades should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal.

- 16.9** Each student shall be required to do **assignment/s** for each course. Assignments after valuation must be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation etc. and inform the same to the students. Punctuality in submission is to be considered.
- 16.10** Every student shall deliver **Seminar / Presentation** as an internal component for every course and must be evaluated by the respective course teacher in terms of structure, content, presentation and interaction. The soft and hard copies of the seminar report are to be submitted to the course teacher.
- 16.11** All the records of Continuous Assessment (CA) must be kept in the college and must be made available for verification by university, if asked for.
- 16.12** There shall be an objective test in the nature of **Fill in the blanks / Multiple Choice Questions (MCQ)** for awarding internal assessment marks for SDE/Private Registration students.

### **17. EXTERNAL / END SEMESTER EVALUATION (ESE)**

- 17.1** The semester-end examinations in theory courses shall be conducted by the University with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation.
- 17.2** After the external evaluation, only Grades are to be entered in the space provided in the answer script for individual questions and calculations need to be done only up to the Cumulative Grade Point (CGP) and all other calculations including grades are to be done by the University.
- 17.3** Students shall have the right to apply for revaluation or scrutiny as per rules within the time permitted for it.
- 17.4** Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny on request by them as per rules.
- 17.5** The external evaluation shall be done immediately after the examination preferably in a Centralized Valuation Camp.
- 17.6** The language of writing the examination shall be specified in the separate regulations for the programme by the concerned BoS.
- 17.7 PATTERN OF QUESTIONS FOR EXTERNAL/ESE :**
- 17.7.1** Questions shall be set to assess the knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. Due weightage shall be given to each module based on content/teaching hours allotted to each module.
- 17.7.2** It has to be ensured that questions covering all skills are set. The setter shall also submit a detailed scheme of evaluation along with the question paper.
- 17.7.3** A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.
- 17.7.4** The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E Grades.

**17.7.5** Weightage: Different types of questions shall be given different weightages to quantify their range given in the following model:

Sl. No.	Type of Questions	Individual weightage	Total Weightage	Number of questions to be answered
1	Short Answer type questions	2	2 x 4 = 8	4 out of 7
2	Short essay/ problem solving type	3	3 x 4 = 12	4 out of 7
3	Long Essay type questions	5	5 x 2 = 10	2 out of 4
<b>Total</b>			<b>30</b>	<b>18</b>

**17.7.6** Questions should be asked as far as possible from all modules following a uniform distribution. However concerned BoS can change the pattern and type of questions subject to the condition that total weightage should be 30.

**17.8** End Semester Evaluation in Practical Courses shall be conducted and evaluated by both Internal and External Examiners as per the stipulations of the concerned BoS. Duration and other aspects of practical external examinations shall be decided by the Boards of Studies concerned.

## 18. EVALUATION OF PROJECT WORK / DISSERTATION

**18.1** There shall be External and Internal evaluation with the same criteria for Project Work done and the grading system shall be followed as per the specific guidelines and stipulations of the concerned BoS.

**18.2** One component among the Project Work evaluation criteria shall be Viva-voce (Project Work related) and the respective weightage shall be 40%.

**18.3** Consolidated Grade for Project Work is calculated by combining both the External and Internal in the Ratio of 4:1 (80% & 20%).

**18.4** Details regarding the conduct of external and internal evaluation, criteria for evaluation and other aspects relating to the same can be taken by the concerned Boards of Studies and shall be specified in the Programme curriculum.

**18.5** For a pass in Project Work, a student has to secure a minimum of **P** Grade in External and Internal examination combined. If the students could not secure minimum **P** Grade in the Project work, they will be treated as failed in that attempt and the students may be allowed to rework and resubmit the same in accordance with the University exam stipulations. **There shall be no improvement chance for Project Work.**

**18.6** The External and Internal evaluation of the Project Work shall be done based on the following criteria and weightages as detailed below :

Sl. No	Criteria	% of weightage	Weightage External	Weightage Internal	Remarks
1	Relevance of the topic and Statement of problem	60%	8	2	Concerned Boards of Studies may conveniently divide this criteria in to various relevant categories and can assign suitable titles provided that the total weightage should be 24 and 6 for External and Internal.
2	Methodology & Analysis		8	2	
3	Quality of Report & Presentation		8	2	
4	Viva-voce	(40%)	16	4	Mandatory criteria
<b>Total Weightage</b>		<b>100%</b>	<b>40</b>	<b>10</b>	

### 19 - CONDUCT OF COMPREHENSIVE VIVA-VOCE

- 19.1** There shall be External and Internal Comprehensive Viva-voce; while the External Conduct of the Viva-voce is mandatory and the Internal conduct of the viva-voce will be optional subject to the decision and stipulation of the concerned BoS.
- 19.2** The concerned Boards of Studies shall design the structure, criteria, details of appointment of Board of examiners (both external and internal) and other relevant aspects of its evaluation.
- 19.3** Deleted.
- 19.4** For a pass in Comprehensive viva-voce, a student has to secure a minimum of **D** Grade in External and Internal examination combined. If the students could not secure minimum **D** Grade in the Project work, they will be treated as failed in that attempt and the student may re appear for the same next time in accordance with the University exam stipulations. **There shall be no improvement chance for Comprehensive viva-voce.**

### 20 - DIRECT GRADING SYSTEM

- 20.1** Direct Grading System based on a 10 – Point scale is used to evaluate the performance (External and Internal Examination of students)
- 20.2** For all courses (Theory & Practical)/Semester/Overall Programme, Letter grades and **GPA/SGPA/CGPA** are given on the following way :
- a) First Stage Evaluation for both Internal and External done by the Teachers concerned in the following Scale :

Grade	Grade Points
<b>A+</b>	<b>5</b>
<b>A</b>	<b>4</b>
<b>B</b>	<b>3</b>
<b>C</b>	<b>2</b>
<b>D</b>	<b>1</b>
<b>E</b>	<b>0</b>

b) The Grade Range for both Internal & External shall be :

Letter Grade	Grade Range	Range of Percentage (%)	Merit / Indicator
O	4.25 - 5.00	85.00 - 100.00	Outstanding
A+	3.75 - 4.24	75.00 - 84.99	Excellent
A	3.25 - 3.74	65.00 - 74.99	Very Good
B+	2.75 - 3.24	55.00 - 64.99	Good
B	2.50 - 2.74	50.00 - 54.99	Above Average
C	2.25 - 2.49	45.00 - 49.99	Average
P	2.00 - 2.24	40.00 - 44.99	Pass
F	< 2.00	Below 40	Fail
I	0	-	Incomplete
Ab	0	-	Absent

**'B' Grade lower limit is 50% and 'B+' Grade lower limit is 55%**

**20.3** No separate minimum is required for Internal evaluation for a pass, but a minimum **P** Grade is required for a pass in the external evaluation. However, a minimum **P grade** is required for pass in a course.

**20.4** A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.

**20.4.1 Improvement of Course-** The candidates who wish to improve the grade / grade point of the external examination of a course/s they have passed already can do the same by appearing in the external examination of the concerned semester along with the immediate junior batch.

**20.4.2 Betterment Programme One time-** A candidate will be permitted to improve the **CGPA** of the Programme within a continuous period of four semesters immediately following the completion of the programme allowing only once for a particular semester. The **CGPA** for the betterment appearance will be computed based on the **SGPA** secured in the original or betterment appearance of each semester whichever is higher.

## **20.5 Semester Grade Point Average (SGPA) – Calculation**

The **SGPA** is the ratio of 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 taken by a student.

After the successful completion of a semester, **Semester Grade Point Average (SGPA)** of a student in that semester is calculated using the formula given below.

$$\text{Semester Grade Point Average - SGPA (S}_j\text{)} = \Sigma(\text{C}_i \times \text{G}_i) / \text{Cr}$$

(SGPA= Total Credit Points awarded in a semester / Total credits of the semester )

Where 'S<sub>j</sub>' is the j<sup>th</sup> semester , 'G<sub>i</sub> ' is the grade point scored by the student in the i<sup>th</sup> course 'c<sub>i</sub> ' is the credit of the i<sup>th</sup>course,'Cr ' is the total credits of the semester .

**Model calculation is given in the Annexure :**

## 20.6 Cumulative Grade Point Average (CGPA) - Calculation

$$\text{Cumulative Grade Point Average (CGPA)} = \Sigma(\text{C}_i \times \text{S}_i) / \text{Cr}(\text{CGPA}=\text{ Total Credit points awarded in all semesters/Total credits of the programme})$$

Where C<sub>1</sub> is the credit of the 1st semester S<sub>1</sub> is the **SGPA** of the 1st semester and **Cr** is the total number of credits in the programme. The **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. The **SGPA** and **CGPA** shall be rounded off to 2 decimal points.

For the successful completion of a semester, a student should pass all courses and score a minimum **SGPA** of 2.0. However, the students are permitted to move to the next semester irrespective of their **SGPA**.

## 21. GRADE CARD

**21.1** The University shall issue to the students grade card on completion of each semester, which shall contain the following information :

- Name of University
- Name of College
- Title of PG Programme
- Semester concerned
- Name and Register Number of student
- Code number, Title and Credits of each Course opted in the semester including Audit Courses
- Letter grade in each course in the semester
- The total credits, total credit points and SGPA in the Semester (corrected to three decimal places)

**21.2** The final Grade card issued at the end of the final semester shall contain the details of all courses taken during the entire programme, including those taken over and above the prescribed minimum credits for obtaining the degree. The final grade card shall show CGPA (corrected to three decimal places), percentage of marks (corrected to two decimal places) and the overall letter grade of a student for the entire programme. The final Grade card will also contain the list of Audit courses.

## 22. AWARD OF DEGREE

**22.1** The successful completion of all the courses with **P** Grade shall be the minimum requirement for the award of the degree

## 23. POSITION CERTIFICATE

**23.1** The University publishes list of top 10 positions for each programme after the publication



of the programme results. Position certificates shall be issued to candidates who secure positions from 1st to 10<sup>th</sup> in the list. The position list shall be finalised after the result of revaluation.

- 23.2** The position list shall be prepared in the order of merit based on the CGPA scored by the students. Grace Grade points awarded to the students shall not be counted for fixing the position.

#### **24. GRIEVANCE REDRESSAL COMMITTEE**

- 24.1 Department Level Committee:** The college shall form a Grievance Redressal Committee in each department comprising of course teacher , one senior teacher and elected representative of Students (Association Secretary) as members and the Head of the Department as Chairman. The committee shall have initial jurisdiction over complaints against Continuous Assessment.
- 24.2 College Level Committee :** There shall be a college level grievance redressal committee comprising of student adviser, two senior teachers , two staff council members (one shall be elected member) and elected representative of students (College Union Chairperson) as members and the Principal as Chairman. This committee shall address all grievances relating to the internal assessment grades of the students.
- 24.3 University level:** The University shall form a Grievance Redressal Committee as per the existing norms.

#### **25. TRANSITORY PROVISION**

- 25.1** Notwithstanding anything contained in these regulations, the Academic Council shall, for a period of three years from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

#### **26. REPEAL**

- 26.1** The Regulations now in force in so far as they are applicable to programmes offered by the University and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the existing regulations and these regulations relating to the Credit Semester System in their application to any course offered in a College, the latter shall prevail.

#### **APPENDIX**

1. *First Phase Evaluation can be done at 6 point scale by assigning the respective Grade Points as detailed below (done by the concerned teacher/examiner)*

<b>Grade</b>	<b>A+</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>Grade Point</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>

2. Calculation of GPA, SGPA & CGPA based on the Direct Grading system using 10 Point Scale as detailed below :

Letter Grade	Grade Range	Range of Percentage (%)	Merit / Indicator
O	4.25 - 5.00	85.00 - 100.00	Outstanding
A+	3.75 - 4.24	75.00 - 84.99	Excellent
A	3.25 - 3.74	65.00 - 74.99	Very Good
B+	2.75 - 3.24	55.00 - 64.99	Good
B	2.50 - 2.74	50.00 - 54.99	Above Average
C	2.25 - 2.49	45.00 - 49.99	Average
P	2.00 - 2.24	40.00 - 44.99	Pass
F	< 2.00	Below 40	Fail
I	0	0	Incomplete
Ab	0	-	Absent

#### **Phases for Evaluation :**

#### **I Phase : To be done by the concerned Teacher /Examiner based on 6 Point Scale**

1. Evaluation of all individual External Theory courses and Internal evaluation
2. Evaluation of Project Work External and Internal
3. Evaluation of External and Internal Practical Courses
4. Evaluation of External and Internal Comprehensive Viva-voce

#### **II Phase - GPA Calculation - To be done by the University**

1. Consolidation of External and Internal for Theory Courses (Calculation of GPA)
2. Consolidation of External and Internal for Project Work (Calculation of GPA)
3. Consolidation of External and Internal for Practical Courses (Calculation of GPA)
4. Consolidation of External and Internal for Comprehensive Viva-voce (Calculation of GPA)

#### **III Phase - SGPA Calculation - To be done by the University**

Calculation of Semester Grade Point Average. This is the consolidated net result (Grade) in a particular Semester.

#### **III Phase - CGPA Calculation - To be done by the University**

Calculation of Consolidated Grade Point Average. This is the consolidated net result (Grade) of a Programme.

#### **Model Calculation of Grade :**

#### **Calculation of overall Grade for one Course (GPA) - Theory External**

**First Phase Evaluation (Done by the concerned Teacher/Examiner) :**

**I - Theory - External :**

Type of Question	Qn. No	Grade Awarded	Grade Point	Weightage	Weighted Grade Point	Calculation	
Short Answer type	1	A+	5	2	10	Overall Grade of the theory paper = Sum of Weighted Grade Points / Sum of the weightage <b>115/30 = 3.83 = Grade A+</b>	
	2	-	-	-	-		
	3	A	4	2	8		
	4	C	2	2	4		
	5	-	-	-	-		
	6	A	4	2	8		
	7	-	-	-	-		
Medium Essay type	8	B	3	3	9		
	9	A+	5	3	15		
	10	-	-	-	-		
	11	-	-	-	-		
	12	-	-	-	-		
	13	A	4	3	12		
	14	B	3	3	9		
Long Essay type	20	A+	5	5	25		
	21	-	-	-	-		
	22	-	-	-	-		
	23	B	3	5	15		
	24	-	-	-	-		
<b>TOTAL</b>				<b>30</b>	<b>115</b>		

Note :1) The total weightage for external evaluation is **30**, (2) Maximum Weighted Grade Point (WGP) is **150 (30 X 5)**,(3) Same way all theory courses can be evaluated.

**II - Theory-Internal :**

Components	Weightage (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Examination /Test	2	A	4	8	<b>WGP/Total weight = 21/5 =4.40</b>
Seminars / Presentation	1	A+	5	5	
Assignments	1	A	4	4	
Viva-voce	1	A+	5	5	
Total	<b>5</b>			<b>22</b>	<b>O</b>

Maximum weight for Internal evaluation is **5**. Therefore Maximum Weighted Grade Point (WGP) is **25 (5 X 5)**.

**III - Project - External :**

Components	Weightage (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Relevance of the topic and Statement of problem	8	A	4	32	<b>WGP/Total weight = 160/40 =4</b>
Methodology & Analysis	8	B	3	24	
Quality of Report & Presentation	8	A+	5	40	
Viva-voce	16	A	4	64	
Total	<b>40</b>			<b>160</b>	<b>A+ - Grade</b>

#### IV - Project - Internal :

Components	Weightage (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Relevance of the topic and Statement of problem	2	A	4	8	<b>WGP/Total weight = 38/10 = 3.8</b>
Methodology & Analysis	2	B	3	6	
Quality of Report & Presentation	2	A	4	8	
Viva-voce	4	A	4	16	
<b>Total</b>	<b>10</b>			<b>38</b>	<b>A+ - Grade</b>

#### **Second Phase Evaluation (Done by the University) :**

#### **V - Theory - Consolidation of Grade (GPA) (Internal + External) :**

The external grade awarded for the Course 1 is 'A' with a Grade point of 3.83 and its internal is 'O'. with a Grade Point of 4.6. The consolidated grade for the course Course 1 is as follows.

Exam	Weightage	Grade awarded	Grade Points (WGP / TOTAL WEIGHTAGE)	Weighted Grade Point
External	4	A+	3.83	15.32
Internal	1	O	4.40	4.40
<b>Total</b>	<b>5</b>			<b>19.72</b>
Grade of a course (GPA)	GPA=Total weighted Grade Points/Total weight <b>19.72/5 =3.94 = Grade A+</b>			

#### **VI - Project Work - Consolidation of Grade (GPA) (Internal + External) :**

Exam	Weightage	Grade awarded	Grade Points (WGP / TOTAL WEIGHTAGE)	Weighted Grade Point
External	4	A+	4	16
Internal	1	A+	3.8	3.80
<b>Total</b>	<b>5</b>			<b>19.8</b>
Grade of a course (GPA)	GPA=Total weighted Grade Points/Total weight <b>19.8/5 =3.96 = A+ Grade</b>			

#### **Third Stage Evaluation :**

#### **CALCULATION OF SGPA (To be done by the University) :**

Course code	Title of the course	Credits (C)	Grade Awarded	Course Grade Points (G)	Credit Points (CP=C X G)	SGPA
<b>I - SEMESTER</b>						
001	Course 1	4	O	4.25	17	SGPA = Total Credit Points /Total Credits = 80.16/20 = <b>4.01</b> <b>Grade - A+</b>
002	Course 2	4	A+	3.9	15.6	
003	Course 3	4	A	3.45	13.8	
004	Course 4	4	A	3.64	14.56	
005	Course 5	4	O	4.8	19.2	

<b>TOTAL</b>		<b>20</b>			<b>80.16</b>	
<b>II - SEMESTER</b>						
006	Course 6	4	A+	3.88	15.52	SGPA = Total Credit Points /Total Credits  = 73.08/20 = <b>3.65</b> <b>Grade – A</b>
007	Course 7	4	A+	3.75	15	
008	Course 8	4	A	3.3	13.2	
009	Course 9	4	A	3.56	14.24	
010	Course 10	4	A+	3.78	15.12	
<b>TOTAL</b>		<b>20</b>			<b>73.08</b>	
<b>III - SEMESTER</b>						
011	Course 11	4	A	3.45	13.8	SGPA = Total Credit Points /Total Credits  = 74.04/20 = <b>3.70</b> <b>Grade – A</b>
012	Course 12	4	A+	3.8	15.2	
013	Course 13	4	O	4.8	19.2	
014	Course 14	4	A	3.58	14.32	
015	Course 15	4	B+	2.88	11.52	
<b>TOTAL</b>		<b>20</b>			<b>74.04</b>	
<b>IV - SEMESTER</b>						
016	Course 16	4	A+	3.85	15.4	SGPA = Total Credit Points /Total Credits  = 76.08/20 = <b>3.80</b> <b>Grade - A+</b>
017	Course 17	4	A	3.6	14.4	
018	Course 18	4	A	3.47	13.88	
019	Course 19	4	A+	3.8	15.2	
020	Course 20	4	O	4.3	17.2	
<b>TOTAL</b>		<b>20</b>			<b>76.08</b>	

**Fourth Stage Evaluation :**

**CALCULATION OF CGPA (To be done by the University) :**

**CGPA for the above case :**

Semester	Credit of the Semesters	Grade Awarded	Grade point (SGPA)	Credit points
I	20	A+	4.01	80.2
II	20	A	3.65	73
III	20	A	3.70	74
IV	20	A+	3.80	76
<b>TOTAL</b>	<b>80</b>			<b>303.2</b>
<b>CGPA (Total credit points awarded / Total credit of all semesters) = 303.2 / 80 = 3.79</b> <b>( Which is in between 3.50 and 3.99 in 10-point scale)</b> <b>Therefore the overall Grade awarded in the programme is - 'A+'</b>				

**GUIDELINES FOR CODING VARIOUS COURSES :**

The following are the common guidelines for Coding various courses in order to get a uniform identification. It is advisable to assign a Seven Digit Code (combination of Alpha Numerical) for various courses as detailed below :

1. **First three digits** indicate the Programme/discipline code (ENG for English, MCM for M.Com, CHE for chemistry, PHY for physics, MLM for Malayalam, SKT for Sanskrit, HTY for History etc)
2. **Fourth digit** is the Semester indicator which can be given as 1,2,3 &4 respectively for I,II,III& IV Semester (MCM1, CHE2 Etc).
3. **Fifth digit** will be the Course Category indicator as detailed below :

SI No	Nature of Course	Course Code
1	Core Courses	C
2	Elective Courses	E
3	Project	P
4	Comprehensive Viva	V
5	Practical / Lab	L
6	Audit Courses	A

4. **Last two digits** indicate the serial number of the respective courses. If there is one digit it should be prefixed by '0'(Zero). (01, 02, etc)
5. If the number of courses in one category is only one (eg : Viva, Project etc.), assign the course serial number as 01.
6. Examples :

SI No	Code	Details
1	MCM1C01	M.Com I Sem Core Course No1
2	CHE 2 A 02	Chemistry II Sem Audit Course No.2
3	ENG 4 V 01	English IV Sem Viva No. 1
4	MLM 3 E 02	Malayalam III Sem Elective No. 2
5	PHY 4 P 01	Physics IV Sem Project Work No. 1
6	BGY 2 L 02	Biology II Sem Practical No. 2
7	PSY 3 C 02	Psychology III Sem Core Coure No. 2
8	HTR 2 E 01	History II Sem Elective Course No. 1

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