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VEER NARMAD SOUTH GUJARAT UNIVERSITY
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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની માર્દકોબાયોલોજી વિષયનો અભ્યાસક્રમ ચલાવતી સંલગ્ન સ્નાતક અને અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ જણાવવાનું કે, શૈક્ષણિક વર્ષ : ૨૦૨૧-૨૨ થી અમલમાં આવનાર શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ અમલમાં આવનાર બી.એસસી. સેમેસ્ટર-૩ અને ૪ તથા એમ.એસસી. સેમેસ્ટર-૩ અને ૪ (માર્દકોબાયોલોજી) વિષયનાં અભ્યાસક્રમ અંગે ચર્ચા કરતા માર્દકોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા. ૧૫/૦૩/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા. ૧૭/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૬ અન્વયે મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલે તેની તા. ૨૫-૨૬/૦૬/૨૦૨૧ ની સભાના ઠરાવ ક્રમાંક: ૨૫ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્ઉપરાંત તેનો અમલ કરવો.

માર્દકોબાયોલોજી વિષયની અભ્યાસસમિતિની તા. ૧૫/૦૩/૨૦૨૧ ની સભાનાં ભલામણ ક્રમાંક:૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ અમલમાં આવનાર બી.એસસી. એન્ડ એમ.એસસી. (માર્દકોબાયોલોજી) સેમેસ્ટર-૩ અને ૪ નાં અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા. ૧૭/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૬

:: આથી ઠરાવવામાં આવે છે કે, માર્દકોબાયોલોજી વિષયની અભ્યાસસમિતિની તા. ૧૫/૦૩/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક:૨ અન્વયે મંજૂર કરેલ શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ અમલમાં આવનાર બી.એસસી. & એમ.એસસી. માર્દકોબાયોલોજી સેમેસ્ટર-૩ અને ૪ નાં અભ્યાસક્રમ મંજૂર કરી એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા. ૨૫-૨૬/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૨૫

:: આથી ઠરાવવામાં આવે છે કે, માર્દકોબાયોલોજી વિષયની અભ્યાસસમિતિએ તેની તા. ૧૫/૦૩/૨૦૨૧ ની સભાના ઠરાવ ક્રમાંક : ૨ અન્વયે ભલામણ કરેલ અને વિજ્ઞાન વિદ્યાશાખાએ તેની તા. ૧૭/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક : ૬ અન્વયે સ્વીકારેલ શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ થી અમલમાં આવનાર બી.એસસી. & એમ.એસસી. માર્દકોબાયોલોજી સેમેસ્ટર-૩ અને ૪ નાં અભ્યાસક્રમ મંજૂર કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૯૨૮૩/૨૧
તા.૦૧-૦૭-૨૦૨૧


ઈ.ચા. કુલસચિવ

પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની માર્દકોબાયોલોજી વિષય ચલાવતી સંલગ્ન કોલેજોના આચાર્યશ્રીઓ.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
- ૪) અનુસ્નાતક વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.



Veer Narmad South Gujarat University,
Surat

M.Sc. (Microbiology) Syllabus
(Effective from June, 2021)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY

Teaching & Evaluation Scheme

Semester III

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB 3001	Fermentation technology	4	-	70	30	100	4
MB 3002	Microbial products	4	-	70	30	100	4
MB 3003	Biochemical engineering	4	-	70	30	100	4
MB 3004	Pharmaceutical microbiology	4	-	70	30	100	4
MBP 3005	Practical	-	16	140	60	200	8
Total		16	16	420	180	600	24

M.Sc.SEMESTER III

MB 3001: FERMENTATION TECHNOLOGY

Student Learning Objective: The objective of this paper is to introduce students to fermentation process and impart knowledge required for fermentation. The paper also provides the information about the industrial applications and recent technological advances in fermentation technology.

UNIT 1	THE ISOLATION AND IMPROVEMENT OF INDUSTRIALLY IMPORTANT MICROORGANISMS
	Teaching Duration: Lectures 09
1.1	Isolation methods utilizing selection
1.2	Isolation methods not utilizing selection of the desired characteristic—from the “waksman platform” to the 1990s of the desired characteristics
1.3	Screening methods and high throughput screening
1.4	Broadening the base of the discovery process and maximizing gene expression
1.5	Improvement of strains producing primary biosynthetic products
1.6	Improvement of strains producing secondary biosynthetic products

UNIT 2	MEDIA FOR INDUSTRIAL FERMENTATIONS
	Teaching Duration: Lectures 09
2.1	Introduction
2.2	Typical media
2.3	Medium formulation
2.4	Water
2.5	Energy sources
2.6	Carbon sources
2.7	Nitrogen sources
2.8	Minerals
2.9	Growth factors
2.10	Nutrient recycle
2.11	Buffers
2.12	The addition of precursors and metabolic regulators to media
2.13	Oxygen requirement and antifoams
2.14	Medium optimization

UNIT 3	FERMENTORS: DESIGN, OPERATION, AND APPLICATIONS
	Teaching Duration: Lectures 09
3.1	Bioreactors: an overview
3.2	Component parts of bioreactors
3.3	Component parts of a “typical” vessel
3.4	Peripheral parts and accessories
3.5	Alternative vessel designs
3.6	Bioreactor instrumentation
3.7	Common measurement and control systems
3.8	Additional sensors
3.9	“Substrate sensors”
3.10	Bioreactor preparation and use
3.11	Examples of common bioreactor applications

3.12	Current trends and future prospects in fermenter design and applications
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UNIT 4	THE RECOVERY AND PURIFICATION OF FERMENTATION PRODUCTS
	Teaching Duration: Lectures 09
4.1	Introduction
4.2	Removal of microbial cells and other solid matters
4.3	Foam separation (floatation)
4.4	Precipitation
4.5	Filtration
4.6	Centrifugation
4.7	Cell disruption
4.8	Liquid–liquid extraction
4.9	Solvent recovery
4.10	Two-phase aqueous extraction
4.11	Reversed micelle extraction and supercritical fluid extraction
4.12	Adsorption
4.13	Removal of volatile products
4.14	Chromatography
4.15	Membrane processes
4.16	Drying
4.17	Crystallization
4.18	Whole broth processing

References:

- Creuger W, Crueger A. and Aneja K. R., (2000) Biotechnology: A textbook of industrial microbiology, 3rd Edition, Panima, New Delhi, (ISBN: 978-93-85998-63-8)
- E.M.T. El-Mansi, Bryce C.F.A., Demain A. L. and Allman A. R., (2012) Fermentation Microbiology and Biotechnology, 3rd Edition, , Taylor & Francis, (ISBN: 978-1-4398-5581-2)
- Okafor N., (2017), Modern industrial microbiology and biotechnology, 2nd edition, Science publishers, USA., (ISBN: 978-1-1385-5018-6)
- Stanbury P. F., Whitaker A. and Hall S. J., (2016), Principles of Fermentation Technology, 3th Edition, , Elsevier, (ISBN: 978-0-08-099953-1)
- Waites, M.J., (2001) Industrial microbiology: An Introduction, 1st Edition, Blackwell publishing, (ISBN: 0-632-05307-0)

MB 3002: MICROBIAL PRODUCTS

Student Learning Objective: Industrial microbiology is a branch of applied microbiology in which microorganisms are used in industrial processes which includes production of high-value products such as drugs, chemicals, fuels and food product. This paper includes the production and processes of various microbial metabolites at industrial scale by use of microbes.

UNIT 1	FERMENTED FOOD AND DAIRY
	Teaching Duration: Lectures 09
1.1	Fungal biomass production: Bakers' yeast
1.2	Milk based fermented foods: Yogurt and Cheese
1.3	Grain based fermented foods: Soy sauce, Soy paste
1.4	Alcohol based fermented products: Beer and Wine
1.5	Vegetable based fermented foods: Sauerkraut and Olives
1.6	Fermented sausages and fish
1.7	Mushroom production

UNIT 2	MICROBIAL FERMENTATIONS
	Teaching Duration: Lectures 09
2.1	Antibiotics: Cephalosporin
2.2	Hormones: Insulin
2.3	Anticancer agents: Anthracyclines
2.4	Organic acids: Citric acid
2.5	Amino acids: L-Lysine
2.6	Enzymes: Cellulase and Protease
2.7	Vitamins: B12

UNIT 3	MODERN TRENDS IN MICROBIAL PRODUCTION - I
	Teaching Duration: Lectures 09
3.1	Biosurfactants
3.2	PHA: Separation, purification and manufacturing methods Encyclopedia of bioprocess tech.
3.3	Carotenoids: β carotene
3.5	Microbial polysaccharides: Dextran
3.6	Microbial flavors: Vanillin, Terpenes
3.7	Microbial biotransformation of steroids and sterols

UNIT 4	MODERN TRENDS IN MICROBIAL PRODUCTION - II
	Teaching Duration: Lectures 09
4.1	Techniques and technologies to produce biomass of cyanobacteria and microalgae
4.2	Single Cell Protein (SCP)
4.3	Bioinsecticides
4.4	Rhizobium inoculants
4.5	Monoclonal antibodies: Production and recovery
4.6	Bacterial siderophores
4.7	Ergot alkaloids

References:

- Adam M. and Dick M., (2014), Food Microbiology: An introduction, 1st edition, Medtec Publication, (ISBN: 978-93-81714-61-4)
- Clarke W., (2016), Biotechnology: Industrial Microbiology, 1st edition, CBS Publishers, (ISBN: 978-81-239-2864-7)
- Flickinger M. C. and Drew S. W., (1999), Encyclopedia of Bioprocess Technology, Volumes 1-5, Wiley-Inter-science, (ISBN: 978-0471138228)
- Okafor N., (2017), Modern Industrial Microbiology and Biotechnology, 2nd edition, Science Publishers, (ISBN: 978-1-138-03614-7)
- Pepler H. J. and Perlman D., (2004), Microbial Biotechnology, Volume 1 and Volume 2, 2nd edition, Academic press, (ISBN: 978-81-8147-495-7/978-81-8147-496-1)
- Ratledge C. and Kristiansen B., (2006), Basic Biotechnology, 3rd edition, Cambridge University Press, (ISBN: 978-0-521-72947-5)
- Reed G., (2004), Prescott & Dunn's Industrial Microbiology, 4th edition, CBS Publishers, (ISBN: 81-239-1001-0)
- Rehm H. J. and Reed G., (2010), Biotechnology, Vol. 10, Wiley India Pvt. Ltd., (ISBN: 978-3527283200)
- Rehm H. J. and Reed G., (2010), Biotechnology, Vol. 7, Wiley India Pvt. Ltd., (ISBN: 978-81-265-2535-5)

MB 3003: BIOCHEMICAL ENGINEERING

Student Learning Objective: This course is designed to impart the knowledge of principle of fermenters and its configuration. Students shall gain knowledge to design, develop and operate industrial level fermentation process and would learn rheological behavior of fluids and mass transfer and population dynamics in a fermentor.

UNIT 1	REACTOR ENGINEERING
	Teaching Duration: Lectures 09
1.1	Bioreactor configurations: Overview
1.2	Monitoring and control of bioreactors
1.3	Bioprocess control
1.4	Sterilization
1.5	Microtiter Plate fermentation: Introduction, Routine and next generation MTP fermenter, Impact on bioprocessing and synthetic biology
1.6	Statistical optimization of fermentation

UNIT 2	FLUID FLOW AND MIXING
	Teaching Duration: Lectures 09
2.1	Classification of fluids
2.2	Fluids in motion
2.3	Factors affecting broth viscosity
2.4	Viscosity measurement
2.5	Non-Newtonian fluids
2.6	Mixing
2.7	Role of shear in stirred fermenters
2.8	Rheological properties of fermentation broths

UNIT 3	HEAT AND MASS TRANSFER
	Teaching Duration: Lectures 09
3.1	Heat transfer equipment
3.2	Mechanisms of heat transfer and conduction
3.3	Heat transfer between fluids
3.4	Relationship between heat transfer, cell concentration and stirring conditions
3.5	Convective mass transfer
3.6	Oxygen uptake in cell cultures
3.7	Oxygen transfer in fermenters
3.8	Measurement of kLa

UNIT 4	MULTIPLE INTERACTING MICROBIAL POPULATIONS
	Teaching Duration: Lectures 09
4.1	Classification of interactions between two species
4.2	Competition
4.3	Predation and parasitism
4.4	Spoilage and product manufacture by spontaneous mixed cultures

References:

- Doran P. M., (2013), Bioprocess Engineering Principles, 2nd Edition, Academic Press, (ISBN 9780122208515)
- E.M.T. El-Mansi, Bryce C.F.A., Demain A. L. and Allman A. R., (2012) Fermentation Microbiology and Biotechnology, 3rd Edition, Taylor & Francis, (ISBN: 978-1-4398-5581-2)
- Ollis D. F. and Bailey J. E., (2010), Biochemical Engineering Fundamentals. 2nd edition McGraw-Hill Education (India) Private Limited, (ISBN: 978-0070701236)
- Vogel H. C and Todaro C. M., (2014), Fermentation and biochemical engineering handbook. 3rd edition, William Andrew publisher, (ISBN: 978-1-4557-2553-3)

MB 3004: PHARMACEUTICAL MICROBIOLOGY

Student Learning Objective: This paper gives insight of microbiological analysis and quality control in pharmaceutical industries. It includes the learning of good manufacturing practices and its monitoring in pharmaceutical companies. The students would also learn quality check and quality maintenance of pharmaceutical products and microbiological auditing.

UNIT 1	BIOPHARMACEUTICAL: INTRODUCTION AND MICROBIOLOGICAL ASSAY
	Teaching Duration: Lectures 09
1.1	Introduction to pharmaceuticals: Microorganisms and medicines
1.2	The agar diffusion assay: Its quantitative basis
1.3	The theory and practice of tube assays for growth promoting substances
1.4	The theory and practice of tube assays for growth inhibiting substances
1.5	Standard reference materials

UNIT 2	MONITORING MICROBIOLOGICAL QUALITY
	Teaching Duration: Lectures 09
2.1	Principles of good manufacturing practice
2.2	Monitoring microbiological quality – Conventional testing methods
2.3	Monitoring microbiological quality – Application of rapid methods

UNIT 3	MICROBIAL ASPECTS OF PHARMACEUTICAL PROCESSING
	Teaching Duration: Lectures 09
3.1	Microbial spoilage and preservation of pharmaceutical products
3.2	Sterilization control and sterility assurance
3.3	The quality assurance and quality control of pharmaceutical products

UNIT 4	PHARMACEUTICAL STERILE PRODUCTS AND MICROBIOLOGICAL AUDITING
	Teaching Duration: Lectures 09
4.1	Types of sterile products: Injections, non-injectable sterile fluids, ophthalmic preparations, dressing, implants, absorbable haemostats, surgical ligatures and sutures, instruments & equipment
4.2	Vaccines: Seed lot system, production, fermentation, blending, filling, and drying
4.3	In-vitro diagnosis
4.4	Immune sera
4.5	Human immunoglobulin & monoclonal antibodies
4.6	Microbiological auditing

References:

- Barredo, J. L., (2005), Microbial Processes and Products. Humana Press, New Jersey, (ISBN: 978-1-59259-847-2)
- Denyer, S. P. and Baird, R. M., (2008), Guide to microbiological control in pharmaceuticals and medical devices. 2nd Edition, CRC Press, Boca Raton, (ISBN: 9781444330632)
- Flickinger, M. C. and Drew, S. W., (1999), Encyclopedia of Bioprocess Technology. Wiley- Interscience, New Jersey, (ISBN: 9780471138228)
- Gad, S. C., (2007), Handbook of Pharmaceutical Biotechnology. Wiley-Interscience, New Jersey, (ISBN: 978-0-470-25958-0)
- Hewitt, W. (2004). Microbiological Assays for Pharmaceutical Analysis-A rational approach, Indian Edition, CRC, (ISBN: 0-203-58859-2)
- Hugo and Russells, (2007), Pharmaceutical Microbiology, Blackwell Publishing.
- Walsh G., (2007), PharmaceurcalBiotechnolog- Concepts and Applications, Wiley (ISBN: 978-0-470-01244-4)

M.Sc. Microbiology Semester III
LIST OF PRACTICALS

MBP-3005

1. Screening of citric acid and lactic acid producing microorganisms.
2. Screening of cellulase, amylase and protease producing microorganisms.
3. Production of fungal amylase by solid state fermentation.
4. Production of fungal amylase by submerged fermentation
5. Partial purification of amylase by ammonium sulphate precipitation and dialysis/column chromatography and calculation of specific activity & fold purification.
6. Determination of *KLa* of laboratory fermenter.
7. Sterility testing of pharmaceutical products by direct inoculation & membrane filtration methods as per Indian Pharmacopoeia (IP).
8. Cell disruption by sonication and estimation of intracellular protein.
9. Production of ethanol using pure carbohydrate.
 - (a) Determination of pH, TSS (°Brix)
 - (b) Determination of alcohol (ethanol) percentage.
 - (c) Determination of phenol content
 - (d) Estimation of reducing & total sugar.
10. Production of ethanol using agro-industrial waste.
 - (a) Determination of pH, TSS (°Brix)
 - (b) Determination of alcohol (ethanol) percentage
 - (c) Determination of phenol content
 - (d) Estimation of reducing & total sugar
11. Microbial production of dextran/xanthan by
Leuconostocmesenteroides/Xanthomonascampestris.
12. Microbiological assay of amino acid.
13. Detection of anti-HIV sera by ELISA.
14. Detection of anti-HBsAgsera by ELISA.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY

Teaching & Evaluation Scheme

Semester IV

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB 4001	Seminar Presentation	4		70	30	100	4
MB 4002	Dissertation	12	16	350	150	500	20
TOTAL		16	16	420	180	600	24

Guidelines for MB 4001 & MB 4002	
MB 4001	<ul style="list-style-type: none"> ➤ Faculty has to mentor the allotted students for selected topics of seminar. ➤ Students have to individually deliver a seminar on the advance or novel topic other than that mentioned in the curriculum. ➤ Teacher has to evaluate seminar of individual student and prepare for the final presentation of the allotted students ➤ Topic should not be related to his/her dissertation. ➤ A seminar should be delivered within 15 minutes. ➤ Students have to submit one copy of colour printed handouts (4 slides /page) of his/her presentation to the examiner.
MB 4002	<ul style="list-style-type: none"> ➤ Faculty has to mentor the allotted students for the dissertation. ➤ Faculty will mentor the students for Scientific writing & communication which includes: <ul style="list-style-type: none"> • Communication skill in science • Searching of scientific journals & resources • Reviewing scientific literature • Preparation of graphs and tables to present the scientific data • Online grammar checking in scientific writing • References management by online tools • Delivering effective oral presentation • Preparing and presenting research poster • Writing a research paper and compiling a dissertation thesis • Plagiarisms checking • Publishing in scientific journal References: <ul style="list-style-type: none"> ▪ Davis M, Davis K. and Dunagan M., (2012), Scientific papers and presentations: Effective scientific communication, 3rd edition, Elsevier and Academic press, (ISBN: 978-0-12-384727-0) ▪ Wallwork A., (2011), English: for writing research papers, Springer science plus Business media, LLC, (ISBN: 978-1-4419-7921-6) ➤ Dissertation work can be done individually or in a pair on any topic related to microbiology. ➤ Dissertation may be carried in-house or outside the campus after due permission granted by the supervising teacher and institute head at the following recognized institutions or industries like: <ul style="list-style-type: none"> • Any UGC recognized University PG departments. • Any Agriculture University. • All National and State level research institute. • ISO or FDA/USFDA industry or research center having R & D and Q.C. facilities. ➤ The thesis will be evaluated by examiner(s) which includes thesis evaluation and dissertation presentation. ➤ The dissertation presentation shall be done in audio-visual mode by the candidate within 15 minutes. ➤ The candidate has to submit their dissertation in a standard hard-bound thesis and soft copy in PDF format.

