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G 501.4E RENEWABLE ENERGY AND ENERGY HARVESTING**(Credits: 02)****Theory: 30 Lectures****Course objectives:**

1. To draw attention towards and develop an understanding about available renewable energy resources.
2. Impart basic theoretical knowledge.
3. Provide hands-on learning on renewable energy harvesting.

Course outcomes:

On successful completion of the course the student must be in a position to :

1. Define basic properties of renewable energy sources.
2. Decide on the viability of a given energy harvesting technology in any given environment.
3. Acquire knowledge of energy storing systems.
4. Realise the environmental impact of renewable energy harvesting technologies.

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **(3 Lectures)**

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(6 Lectures)**

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **(3 Lectures)**

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. **(3 Lectures)**

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **(2 Lectures)**

Geothermal Energy: Geothermal Resources, Geothermal Technologies. **(2 Lectures)**

Hydro Energy: Hydropower technologies, environmental impact of hydro power sources.

(2 Lectures)

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials, modelling piezoelectric generators, piezoelectric energy harvesting applications **(4 Lectures)**

| | |
|---|---------------------|
| Electromagnetic Energy Harvesting: Linear generators, recent applications | (2 Lectures) |
| Carbon captured technologies, cell, batteries, power consumption | (2 Lectures) |
| Environmental issues and Renewable energy sources, sustainability. | (1 Lecture) |

Demonstrations and Experiments

1. Field Visit/ Industrial Visit
2. Demonstration of Training modules on Solar energy, wind energy, etc.
3. Conversion of vibration to voltage using piezoelectric materials
4. Conversion of thermal energy into voltage using thermoelectric modules.

Reference Books:

Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi

- Solar energy - M P Agarwal - S Chand and Co. Ltd.
- Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
- Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004,
- Oxford University Press, in association with The Open University. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
- http://en.wikipedia.org/wiki/Renewable_energy

G502.4E: Chemistry in Everyday Life**UNIT I****Cosmetics and Toiletries Industry****10 Hrs**

Raw materials: Surfactants – structure, types (anionic, cationic, nonionic and zwitterionic) hydrophilic lipophilic balance (HLB); Thickeners, foam stabilizers, natural oils, emulsifiers, humectants (definition, types and examples), plasticizers.

Hair-care products – Structure of hair keratin, major components of shampoo, hair dyes (mechanism and composition), Health & Environmental concerns.

Skin care products – skin structure, sunscreens, fairness creams, moisturizers, Health & environmental concerns.

Nail polish – formulation, manufacture and safety concerns.

Perfumes – Perfumes and odours in nature, synthetic perfumes, ingredients, chemoreception.

Polymers in Everyday Life**5 Hrs**

Natural and synthetic polymers – Properties, classification and structures, polymers and the environment, recycling of polymers.

Natural polymers – cellulose, starch, polysaccharides, proteins, polyisoprene.

Synthetic polymers – Rubber, Adhesive, paints, silicones and plastics.

UNIT II**Drugs and Medicines****15 Hrs**

General principles of drug action; classification on the basis of origin and therapeutic use; different routes of drug administration; mechanism of drug action.

Drug-receptor interactions – Covalent, ionic, hydrogen bonded, Vander Waals and hydrophobic/hydrophilic interactions.

Chemistry of Prodrugs – Concept; applications; some important prodrug concepts (to improve chemical stability, increased water solubility, decrease toxicity).

General anaesthetics – Introduction and classification, Examples (nitrous oxide, chloroform).

Local Anaesthetics – Definition, properties of ideal local anaesthetics; Examples (Benzocaine, lidocaine).

Sedatives and hypnotics – Classification (Barbiturates and non-barbiturates); Chemistry of Barbiturates – Examples, structure-activity relationship, mechanism of action and uses of Barbiturates.

Non-steroidal Anti-inflammatory Drugs (NSAIDs) – Definition, general structure and Classification – Salicylates (Aspirin, Salol) and Propionic acid (Ibuprofen).

UNIT III

Reference Books:

1. *Chemistry and technology of the cosmetics and toiletries industry*, D. F. Williams, W. H. Schmitt (1992), Kluwer Academic Publishers.
2. *The chemistry of fragrances: From Perfumer to Consumer*, Charles Sell, 2nd Ed. (2015), Royal Society of Chemistry.
3. *Medicinal Chemistry*, Ashutosh Kar, 7th Ed. (2018), New Age Publishers.
4. *Principles of organic medicinal chemistry*, R. R. Nadendla (2005), New Age Intl Publishers.
5. *Essentials of pharmaceutical chemistry*, Donald Cairns, 4th Revised Ed. (2012), Pharmaceutical Press.

G 503.4E Skill Development Techniques in Mathematics
Using Computer Aided Tools
30 Hours, 2 hours/week

Unit I**(15 Hours)**

Use of Mathematica, in computing functions, plotting graphs, finding eigen values, eigen vectors.

Unit II**(15 Hours)**

Elements of LaTeX; Hands-on-training of LaTeX ; graphics in LaTeX; Beamer presentation.

References

1. Michael Trott, *A Mathematica Guidebook for Programming*, Springer; 2004 edition (17 November 2004).
2. Stephen Wolfram ,*TheMathematica Book* ,5th Edition , Wolfram Media Inc,2003 .
3. Stefan Kottwitz, *Latex Beginners Guide*, Packt Publishing, 2011.
4. George Gratzer, *Practical Latex*, Springer , 2014 edition.

**G 504.4E: PRINCIPLES OF MEDICAL ELECTRONICS AND
BIOMEDICAL INSTRUMENTATION**

Course Objective:

The student should be made:

- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters.
- To study about the various assist devices used in the hospitals.
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

Course Outcome:

On successful completion of this course, the student should be able to:

- Know the human body electro- physiological parameters and recording of bio-potentials.
- Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood flow meter etc.
- Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.
- Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods.
- Know about recent trends in medical instrumentation.

SYLLABUS

UNIT I

Biomedical transducers: Classification and Selection, Resistive, capacitive & Inductive transducers, Piezo-electric, Temperature and Digital transducers; Principles of working and their characteristics.

3hrs

Physiological Signals: Cell and its structure – Resting and Action Potential, propagation of action potentials, Types of Physiological Signals, Development of biomedical instrumentation, characteristics for designing medical equipment, man instrument system components block diagram.

3hrs

Electrodes & Amplifiers: Principles of working and their characteristics, Electrode-Electrolyte model. Microelectrodes, Amplifiers for biomedical instrumentation.

3hrs

Instrumentation for Measurements: Basics of ECG, EMG, EEG, and Instrumentation for measuring these signals, Measurement of blood pressure & blood flow.

3hrs

Cardiac Pacemakers: block diagram & its working principle, Types of pacemakers.

1hr

Defibrillators: block diagram, Mechanism, AC defibrillators and Capacitive Discharge DC defibrillators.

2hrs

UNIT II

Biomedical Equipments: Basic Medical Instrumentation System, Respiratory measurements and aids: Principles and Techniques of Impedance Pneumograph.

3hrs

Electrosurgical units (ESU): modes of operation of the ESU & the safety features.

1hr

Ventilator: Block diagram and working and its types.

2hrs

Audiometer: Block diagram and working and its types. Hearing aids: Different types, Comparison of microphones,

2hrs

Ultrasonics: Basic principle, block diagram of an echocardiograph. Study of Endoscopes, Neonatal instrumentation.

3hrs

Heart-Lung Machine: Governing principles, block diagram, Qualitative requirements and types of blood oxygenators.

2hrs

Haemodialysis: block diagram, Qualitative requirements, General scheme of operations, Types of exchangers, Block diagram of the dialysis machine, Electronic control and monitoring systems.

2hrs

References:

1. John G Webster, "Medical Instrumentation", John Willey, Edition 3, 2001.
2. R S Khandpur, "Hand book of Biomedical Instrumentation", TATA McGraw Hill, Edition 2, 2003.
3. Richard Aston, "Principles of Biomedical Instrumentation and Measurements", Maxwell macmilan International editions.
4. LA Geddes & LE Baker, " Principles of Applied Medical Instrumentation", John Wiley Edition 3, 1989.
5. Leslie Cromwell, "Biomedical Instrumentation and Measurements", Prentice Hall, Edition 2, 2000.

G 505.4E Office Automation (1 +1 Lab)

Introduction to open office/MS office/Libre office (1 Hour)

Word Processing: Formatting Text, Pages, Lists, Tables (5Hours)

Spreadsheets: Worksheets, Formatting data, creating charts and graphs, using formulas and functions, macros, Pivot Table **(5 Hours)**

Presentation Tools: Adding and formatting text, pictures, graphic objects, including charts, objects, formatting slides, notes, hand-outs, slide shows, using transitions, animations **(4Hours)**

Books Recommended:

1. SushilaMadan , Introduction to Essential tools,JBA,2009.
2. Anita Goel, Computer Fundamentals, Pearson, 2012

G 506.4E STATISTICAL DATA ANALYSIS USING SPSS

Objectives:

1. To train students in SPSS Software.
2. To expose the students to the analysis of statistical data.

UNIT I

Descriptive Statistics: Measures of averages, Measures of variation, Kurtosis.

Correlation: Karl Pearson's and Spearman's Rank Correlation, Regression analysis:

Simple Regression Analysis.

10 hrs.

UNIT II

Introduction to SPSS: Description of SPSS menu, import from other data source, data entry, labelling for dummy numbers, recoding of the variables, transpose of data, insert variables and cases merge variables and cases.

10 hrs.

UNIT III

Data handling: Split, select cases, transform, compute total scores and table looks, changing column, font style and sizes. Diagrammatic representation: Simple bar diagram, Multiple bar diagram, Sub-divided bar diagram, Percentage bar diagram, Pie diagram, Frequency table, Histogram, Scatter diagram, Box plot.

10 hrs.

References:

1. Darren George & Paul Mallery (2019), IBM SPSS Statistics 25 Step by Step, 15th Ed., ISBN: 978-1-138-49104, Taylor & Francis.
2. Ronald D. Yockey (2018), SPSS Demystified-A Simple Guide and Reference, 3rd Ed., Taylor & Francis.
3. Ajay S. Gaur & Sanjana S. Gaour (2009), Statistical Methods for Practice and Research: A Guide to Data Analysis using SPSS, ISBN: 9788132101000.

G 507.4E NURSERY AND GARDENING

Choice based credit system – **Interdisciplinary**-An elective course which enables an exposure to some other discipline/domain

30 Hours (2 hrs/week)

Course outcome

On completion of this course student will be able :

- To understand the the concept and importance of gardening
- To maintain a nursery
- To commercialize the knowledge

Unit I

15 Hrs

Introduction: Definition, objectives, scope and building up of infrastructure for nursery

Planning and seasonal activities - Planting - direct seeding and transplants. Nursery Management and Routine Garden Operations. Different types of gardening- Landscape and home gardening - parks and its components, plant materials and design

Gardening operations: soil laying, manuring, watering.

Principles of organic farming ,Management of pests.

Green house - mist chamber, shade house and glass house for propagation.

Unit II

15 Hrs

Propagation methods: Sowing/raising of seeds and seedlings, transplanting of seedlings. Air-layering, cutting, selection of cutting , propagule collecting season, treatment of cutting , rooting medium and planting of cuttings, Hardening of plants.

Ornamental Plants with examples: Flowering annuals; herbaceous, perennials, Divine vines, Shade and ornamental trees, Ornamental bulbous and foliage plants, Cacti and succulents, Ornamental palms, Medicinal, Aromatic plants and Hydrophytes

Cultivation of plants in pots, Indoor gardening, Bonsai.

Cultivation of Important flowers (Anthuriums, Orchids, Marigold, Jasmine)

References

1. Ratha Krishnan, P., Rajwant K. Kalia, Tewari, J.C. and Roy, M.M. 2014. Plant Nursery Management: Principles and Practices. Central Arid Zone Research Institute, Jodhpur.
2. Smith E.C. 2009. Vegetable garden bible. Storey Publishing LLC, USA.
3. Uberoi M. 2002. The Penguin Book of Gardening in India. Penguin random house publishers, New Delhi
4. Batth A.S. 2016. Home Gardeners' Guide Indian Garden Flowers, New Delhi.

G 508.4E NATURE AND WILDLIFE PHOTOGRAPHY

Basic concepts of photography

- | | |
|--|-------------|
| 1. Introduction to photography: History and evolution of photography. | 2hrs |
| 2. Types of photography | 2hrs |
| 3. Basics of photography: Focusing, aperture, ISO, shutter speed. | 3hrs |
| 4. Lighting | 1hr |
| 5. Depth of field | 2hrs |
| 6. Types of camera- Point and shoot camera, bridge camera, SLR and DSLR. | 2hrs |
| 7. Choice of camera and lenses for nature and wildlife photography | 3hrs |

Advanced skills and techniques:

- | | |
|--|-------------|
| 8. Autofocus and manual focus | 1hr |
| 9. Exposure: Metering modes and their use | 1hr |
| 10. Use of flash in photography | 1hr |
| 11. Other tools used in photography | 2hrs |
| 12. Rules of composition | 1hr |
| 13. Post processing techniques in Light room and Photoshop | 3hrs |
| 14. Macro and landscape photography | 2hrs |
| 15. Bird and mammal photography | 3hrs |
| 16. Rules and codes of ethical nature/wildlife photography | 1hr |

References

1. Tharp, B. (2010) Creative nature and outdoor photography. Revised Edition, Amphoto Books. Canada.
2. Peterson, B. (2016) Understanding exposure, IV Edn, Amphoto books, Ontario, Canada.
3. Weston, C. (2008) Nature photography: Insider secrets from the world's top digital photography professionals, Routledge publishers, London, UK.
4. Owen, D. (2019) Park Ranger's guide to nature and wildlife photography, Amherst Media, New York.

5. Farrell, I. (2014) Complete guide to digital photography, Quercus publishers. London, UK.
6. Ballard, J. (2017) Wildlife photography: Proven techniques for capturing stunning digital images, Falcon guides. UK.
7. Gerlach, J. and Gerlach B. (2013) Digital wildlife photography, Routledge publishers, London, UK.
8. Freeman, J. (2015) Complete practical guide to digital and classic photography, Southwater publishers. Leicester, UK.
9. Alderfer, J. (2007) National Geographic birding essentials: All the tools, techniques, and tips you need to begin and become a better birder, National Geographic. Washington DC.
10. Bernabe, R. (2018) Wildlife Photography, Ilex press, Lewes, UK.
11. Caputo, R. (2007) National Geographic: The ultimate field guide to landscape photography (National Geographic photography field guides), National Geographic, Washington DC.
12. Arbari, S. (2011) The complete guide to nature photography: Professional techniques for capturing digital images of nature and wildlife, Amphoto books. Ontario, Canada.
13. Boyer, T. (2018) Learn the art of bird photography: The complete field guide for beginning and intermediate photographers and birders, Createspace Independent Publishing Platform. California, US.

G509.4E SOLID WASTE MANAGEMENT**Course Learning Outcomes**

Outcome 1. Understand the concepts categories of solid waste

Outcome 2. Have developed a very good understanding of types of e-waste.

Outcome 3. Gained knowledge of a variety of methods of safe disposal of solid and e-waste.

4. ELECTIVE -OPEN ELECTIVE - IV SEMESTER -SOLID WASTE MANAGEMENT-G509.4E**CREDIT: 1****TOTAL HOURS: 30 HOURS**

UNIT-1.Definition of a Solid Waste, Categories of Wastes , Municipal Solid Waste, Hazardous Waste ,Industrial, Waste. Medical Waste, Universal Waste, Electronics Waste Construction and Demolition Debris .Radioactive Waste Mining Waste, Agricultural Waste Generation of MSW, Solid Waste Management Source Reduction Recycling. Incineration Land Disposal. **Common Components in Municipal Solid Waste**

Electronics Waste: Introduction : Major Types of Electronic Equipment Computers, Cathode Ray Tube Computer Monitors Computer Desktop Telecommunications Equipment (Telephones, Fax Machines Mainframe Computers and High-End Telecommunications Equipment, Televisions with CRTs, Flat Screen Televisions, Telephones, Hazards of e-Waste: Cathode Ray Tubes, Computers Wastes Hazardous Waste ,EPA CRT Rule, Boards, Electronics Recycling Residential Collection Programs ,Reuse and Resale, Deconstruction, Processing and Recycling e-Waste Components CRT Glass Metals Circuit Boards. Central Processing Units , Computer Peripherals

UNIT-2

Composting MSW, Introduction ,Composting, Overview of the Composting Process, Role of Microorganisms in Composting , Factors Affecting the Composting Process: Preprocessing of the Feedstock ,Environmental Factors, C:N Ratio ,Aeration, Moisture Content, Temperature, PH, Composting Stage Turned Piles Turned Windrow, Aerated Static Piles, In-Vessel Systems Stage Environmental Concerns during Composting Air Quality, Odor Noise, Toxins within the Pile, Leachate, Runoff Litter.

REFERENCES:

WASTE MANAGEMENT PRACTICES Municipal, Hazardous, and Industrial, Industrial, Second Edition John Pichtel , CRC Press Taylor & Francis Group6000 Broken Sound Parkway NW.

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G 510.4E MOLECULES OF LIFE**30 Hours (1 credit)****Unit-I****15 hours**

Carbohydrate: Introduction, Biological importance, classification. Monosaccharides, Disaccharides and polysaccharides (Definition, sources and examples). Blood sugar and diabetes mellitus, obesity (causes, symptoms and treatment). **Amino acids:** Definition and nutritional classification. Amino acid metabolic disorders: Phenylketonuria and albinism. **Protein:** Definition, biological importance and nutritional classification. Peptide bond, biologically important peptides. Malnutrition: Kwashiorkor and Marasmus.

Unit-II**15 hours**

Lipids: Classification and properties. **Fatty acids:** Classification and properties of fatty acids (rancidity and Saponification). Lipoproteins: types and function. Serum lipid profile, Hypercholesterolemia and atherosclerosis. **Nucleic acids:** Introduction, nitrogenous bases - purines and pyrimidines, nucleosides, nucleotides, phosphodiester bonds. Types and functions of DNA and RNA. Biological importance of DNA and RNA. Gout (Causes, symptoms and treatment).

References:

1. Fundamentals of Biochemistry (2005) by J.L Jain, 6th Ed, S. Chand & Co Ltd. ISBN: 81-219-2453-7.
2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10: 1-4292-3414-8.
3. Physical Biochemistry (2009) 2nd ed., Sheehan, D., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.
4. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.
5. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN: 978-1180-25024.
6. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2
7. Biochemistry (2013) by U. Satyanarayana and U. Chakrapani, 4th edition, Elsevier.
8. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New Jersey), ISBN: 978-0-470-28173-4. 3.

G 511.4E- IMMUNE SYSTEM AND DISEASE MANAGEMENT

CREDITS: 2

TOTAL HOURS: 30

Unit 1

10hrs

Introduction

Brief history to immunology, innate and adaptive immunity – skin, physiological, phagocytic and inflammation, lymphocytes, Cells and Organs of Immune system, Antigen and antibody structure & functions

UNIT II

10hrs

Microbial Diseases

The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control

Bacterial diseases: Respiratory Diseases: *Haemophilus influenzae*, *Mycobacterium tuberculosis*

Gastrointestinal Diseases: *Salmonella typhi*, *Vibrio cholerae*

Viral diseases: Polio, Hepatitis, Rabies, Dengue, Influenza with brief description of swine flu, Ebola, Nipah virus

Protozoan diseases: Malaria, Kala-azar

Fungal diseases: Cutaneous mycoses: Tinea pedis (Athlete's foot); Systemic mycoses: Histoplasmosis; Opportunistic mycoses: Candidiasis

Sexually transmitted diseases (STD): Types, route of infection, clinical symptoms and prevention.

Unit III

10hrs

Vaccines & Cancers

Active and passive immunization, types of vaccines. Cancer-types of cancer, causes of cancer.

REFERENCES

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
3. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
4. Goldsby R. A., Thomas J. K, Osborne B A., 2007. Kuby Immunology, W. H. Freeman and Company, New York.

G 512.4E Video Editing**UNIT I:**

Over view of the editing process, Advantages, elements of editing, Principles of editing, Non-linear versus linear editing, video capture, formats and resolution, Analog versus Digital - the difference, Titles and credits, safe titles, Transitions-Fades, Cuts, Dissolves, Wipes, Keying & Layering, formats- Avi, MPG-2, Mov, Wmv, VCDs and DVDs, Internet formats, VHS , 3D compositing, DI process in films. **(12 Hrs)**

UNIT II:

Video and audio editing softwares, Capturing and gathering media Build and organizing, importing, Rough cut, Trim the story, Motion Effects Text, Multiclip Filtering and Keying, Organizing Clips In The Browser, THE Creation of Sequences and BINS, The Icon View and Columns View, Marking Controls. **(12 Hrs)**

References:

1. The Art and Science of Digital Compositing, Morgan Kaufmann by Ron Brinkmann, 1999
2. Digital Compositing for film and Video, Focal Press, 2006
3. PC Audio Editing, Focal Press, by Roger Derry, 2003
4. Editing Digital Video (Digital Video and Audio Series),
5. Adobe Premiere Pro CC Classroom in a Book, By Maxim Jago. By Adobe

G 513.4E QUANTITATIVE ECONOMICS**2 hours per week (Total: 30 hours)****LEARNING OBJECTIVES:**

- To acquaint the students with elementary knowledge of mathematical techniques in Economics.
- To train them to use mathematical techniques in economics.

LEARNING OUTCOMES:

- The Student will be able:
- To Apply some mathematical methods to economic theories
- Using calculus and differential equations in the economic models
- Use economic integration in applications

MODULE I: LINEAR FUNCTIONS AND THEIR APPLICATION IN ECONOMIC ANALYSIS (10 hours)

Linear Function - Demand Function - Supply Function - Market Equilibrium - Taxation - Subsidy - Elasticity of Demand- National Income Determination.

MODULE II: NON- LINEAR FUNCTIONS AND THEIR APPLICATION IN ECONOMIC ANALYSIS. (10 hours)

Quadratic Function - Simple and General market Market Equilibrium - Production Possibility Curves - Power Function - Pareto's Distribution of Income - Logarithm and Anti- Logarithms- Exponential Function - Interest Compounding, Discounting

MODULE III: DIFFERENTIAL AND INTEGRAL CALCULUSAND THEIR APPLICATION IN ECONOMIC ANALYSIS. (10 hours)

Application of Derivatives in Economics - Cost - Average and Marginal Cost Relationship - Revenue - Average and Marginal Relationship -Equilibrium of the Firm under perfect competition, monopoly, price discrimination. Integral Calculus Definite Integration - Application to Economics - Consumers Surplus - Producers Surplus - - Indefinite Integration - Cost and Revenue Analysis , National Income Analysis

BOOKS FOR REFERENCES:

1. Allen, R.G.D. , 2007. : *Mathematical Analysis for Economists*, Macmillan, Mumbai
2. Bhardwaj, R.S., 2007: *Mathematics for Economics and Business*, 2nd Ed. Excell Books, NewDelhi.
3. Chiang, A.C. ,1985: *Fundamental Methods of Mathematical Economics*, 3rd Ed. McGraw Hill Mumbai.
4. Dinwiddy, C., 1967, *Elementary Methods of Mathematical Economics*, Oxford University Press
5. Dowling, E.T, 2005: *Introduction to Mathematical Economics*,2nd Ed. Schaum's Outline Series, MacGraw Hill, Mumbai.
6. Halden, K. and A.W. Pearson, (2002): *Introductory Mathematics for Economics and Business*, Macmillan Press Ltd, Delhi.
7. Mehta & Madnani : 1992: . *Mathematics for Economists*, S. Chand, New Delhi.
8. Simon, Carl P. and Lawrence Blume, 2007 : *Mathematics for Economics*, Viva Books Pvt Ltd, NewDelhi.
9. Veerachamy, R., 2008 : *Quantitative Methods for Economists*, New Age International Publications, New Delhi.
10. Weber, Jean E. ,1982: *Mathematical Analysis* , Harper International.
11. Yamane, T., 2011: *Mathematics for Economists*,2nd Ed. PHI Learning, NewDelhi.
