RASHTRASANT TUKADOJI MAHARAJ
NAGPUR UNIVERSITY

Ph. D. Entrance Test

2020-2021

Syllabus of Section A & Section B

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus and Question Paper Pattern for Ph.D Entrance Test (PET)
Section A - Research Methodology and General Aptitude
(As prescribed by the Direction No. 6 of 2021 issued by the Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Maximum Marks: 50 (50 Multiple Choice Questions carrying 1 Mark each)

Maximum Time: 90 Minutes

Research Methodology (40 questions of 1 Mark each)

1. **Meaning and Types of Research:** Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Research and Scientific Method, Criteria of Good Research

2. **Principles of Review of Literature:** Meaning of Literature Review, Importance of Literature Review, Purposes of Literature Review, Sources of Literature Review, Steps in Literature Review, Essentials of a Good Literature Review

3. **Defining a Research Problem:** What is a Research Problem?, Selecting the Problem, Necessity of Defining a Problem, Problem Definition Process, Techniques involved in Defining a Problem

4. **Research Designs:** Meaning of Research Design, Need for Research Design, Features of a Good Research Design, Important Concepts relating to Research Designs, Types of Research Designs, Basic Principles of Experimental Design

5. **Preparing a Research Proposal:** Need for a Research Proposal, Contents of a Research Proposal, Research Proposal as a Planning Tool

6. **Sampling Techniques:** Census and Sample Survey, Implications of a Sample Design, Steps in Sample Designing, Features of a Good Sample Design, Types of Sampling Procedures, Criteria for selecting a Sampling Procedure

7. **Types of Data and Data Collection Techniques:** Significance of Data in Research, Types of Data – Primary and Secondary, Sources of Secondary Data, Methods for collecting Primary Data, Selection of Appropriate Method for Data Collection

8. **Data Analysis Tools:** Significance of Data Analysis, Statistical Tools for Data Analysis – Measures of Central Tendency, Measures of Dispersion, Measures of Relationship, Correlation and Regression Analysis, Other Tools

9. **Referencing Styles:** What is Referencing?, Difference between Referencing and Bibliography, What Needs to be Referenced?, Different Types of Referencing Styles - APA Style, Chicago Manual Style, MLA Style, Sources of References, Elements in a Reference List, Referencing Tools

General Aptitude (10 questions of 1 Mark each)

a. Analytical Reasoning
b. Numerical Ability
c. Data Interpretation
d. Computer Awareness
e. Language Competency

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SYLLABUS FOR PhD ENTRANCE TEST(PET) : PHARMACY :

SECTION B : PAPER II, 50 MCQS, 50 MARKS, 90 MIN

UNIT 1
PHARMACEUTICS
SUB UNIT A

1. Solutions

Solubility, factors affecting solubility, solubility curves. Types of solutions, effect of co-solvency, pH & other factors on solubility. Solubility of gases in liquids, liquids in liquids, & solids in liquids, critical solution temperature, law of partitioning & its applications. Solute-solvent interactions. Expression of the concentration of pharmaceutical solutions & calculations. Molarity, molality, mole fraction & percentage expressions.

2. Surface and interfacial phenomenon

Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption and liquid interfaces, surface active agents, HLB classification, solubilization, detergency, absorption at solid interfaces, solid gas and solid-liquid interfaces, complex films, electrical properties of interfaces.

3. Viscosity and rheology

Newtonian systems, law of flow, kinematics viscosity, effect of temperature, non- Newtonian systems, pseudoplastics, dilatant, plastic, thixotropy in formulations, determination of viscosity and thixotropy by capillary, falling ball, rotational viscometer, application of theology in pharmacy

4. Dispersion systems

a. Colloidal dispersions: Definition, types, properties of colloids, protective colloids, application of colloids in pharmacy.

b. Suspensions and emulsions: Interfacial properties of suspended particles settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles,   significance of electrical properties in dispersions, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsions: types, theories, physical stability.

5. Complexation

Classification of complexes, methods of preparations and analysis, applications.

SUB UNIT B

6. Tablets

Types, ideal requirement, classification, excipients, granulation methods, general formulation, compression machines, different types of tooling's, difficulties in tableting, troubleshooting aspects, evaluation, sugar coating, compression coating, film coating, problems in tablet coatings and their troubleshooting aspects.

7. Parenterals - product requiring sterile packaging

General formulation, vehicles, production procedure, production facilities, controls, tests and evaluations as per I.P., sterile powders, implants, emulsions, suspensions.

8. Preformulations

Consideration of Importance, physical properties : physical forms, particle size, crystal forms, bulk control, solubility and solubility profile, wetting, flow cohesiveness, compressibility, organoleptic properties and its effect on final product. Chemical properties: hydrolysis, oxidation, recemization, polymerization, isomerization, decarboxylation, enzymatic decomposition . BCS classification of drugs and its significant

9. Stability of formulated products

Requirements, drug regulatory aspects, pharmaceutical products stability, shelf life, overages, containers, closures, accelerated stability testing ,ICH guidelines: Overview of Q series guidelines, ICH stability testing guidelines .

SUB UNIT C

10. **Controlled drug delivery system** : Selection of drug candidates, approaches to design control release formulation based on diffusion, dissolution and ion exchange principles, physiological and biological properties of drugs affecting control release formulations.

11. **Novel Drug delivery system:** Critical fluid technology, transdermal drug delivery system, multiple emulsion, nanoparticles, targeted drug delivery system, aerosols, inhalation , microencapsulation, mucosal drug delivery system, Implantable drug delivery sysyem, Gastroretentive drug delivery system, Ocular Drug delivery system, Nasopulmonary drug delivery system, Intrauterine drug delivery system.

12. **Pelletes** : Formulation requirements , pelletization process, pelletization equipment and manufacturing.

13. **Validation** : Types of validation. The brief Methodology of process, equipment and instrument validation.

UNIT 2

PHARMACEUTICAL CHEMISTRY

SUB UNIT A.

ORGANIC CHEMISTRY
Carbonyl Chemistry: Carbonyl chemistry involving group conversions & their reaction mechanisms along with stereochemistry wherever applicable.
a. Wolf-Kishner reduction & Huang-Minlong modification.
b. Bamford Steven reaction.
c. Michael addition / 1,4-addition / conjugate addition.
d. Mannich condensation / reaction.
e. Stobbe condensation.
g. Beckmann rearrangement.
h. Baeyer Villiger rearrangement.
i. Pinacol-pinacolone rearrangement.

SUB UNIT B

PHARMACEUTICAL CHEMISTRY
Introduction to quantitative structure-activity relationship. [QSAR]: Linear free energy relationship. Hammett's equation. Use of substituent constants such as π, σ, Es, & physicochemical parameters such as pKa, partition coefficient, Rm, chemical shifts, molar refractivity, simple & valance molecular connectivity to indicate electronic effects, lipophilic effects, & steric effects. Introduction, methodology, advantages & disadvantages/limitations of Hansch analysis.
Combinatorial chemistry: Introduction & basic terminology. Databases & libraries. Solid phase synthesis technique. Types of supports & linkers, Wang, Rink, & dihydropyran derivatized linkers. Reactions involving these linkers. Manual parallel & automated parallel synthesis. Houghton's tea bag method, micromanipulation, recursive deconvolution. Mix & split method for the synthesis of tripeptides. Limitations of combinatorial synthesis. Introduction to throughput screening.

SUB UNIT C

PHARMACEUTICAL ANALYSIS
Ultraviolet-visible Spectrometry: Different electronic transitions. Auxochromes & their effects, auxochromic, bathochromic & hypsochromic shifts. Beer-Lambert law, its derivation, deviations in Beer's law. Single & double beam spectrophotometers covering sources of radiations, different monochromators, detectors such as barrier cell, photocell, photomultiplier tube. Photodiode array. Applications of this technique in qualitative & quantitative estimations giving emphasis on problem-solving. Fieser-Woodward rules for calculations of theoretical λmax values.
Infrared spectrometry: Infrared region in EM spectrum. The principle, different stretching & bending vibrations. Components [& their working] of a dispersive instrument. Fourier transform [FT] technique, & their comparison with dispersive instruments. Sample handling techniques. Functional groups identification & their use in the characterization of compounds. Problems based on the identification of functional groups from spectra of unknown compounds.

Proton nuclear magnetic resonance spectrometry: The principle involved in the technique. Knowledge about fundamental terms involved: quantized absorption, flipping of nucleus, spin number, magnetic moment, magneto-gyric ratio, relaxation. Equations relating these terms to the frequency of radiation & magnetic field [without derivation of the equations]. Types of relaxation processes. Low & high-resolution instruments. Quantitative knowledge of the relationship between MHz & magnetic field. An introduction to superconductivity magnets. Solvents & reference standards used. Shielding & de-shielding of a proton & its effect on chemical shifts. Discussion on & importance of equivalent & non-equivalent protons [number of signals], chemical shifts [position of signal] & their calculation from the spectrum, chemical shifts of different H's, splitting [multiplicity] of a signal, coupling constants [J values], integration [area under the signal].

Mass spectrometry: Principle. Low & high-resolution instruments. Components & importance of each in brief. Different types of mass spectrometric techniques. Brief knowledge of Chemical Ionization mass spectrometry. Calculations of hydrogen deficiency index [HDI] or unsaturation index [UI]. Base or parent peak, molecular ion, Metastable ion, Isotope peaks. Major modes of fragmentations of hydrocarbons, hydroxyl compounds, halogen compounds, aldehydes, ketones, carboxylic acids, and amines.

UNIT 3

PHARMACOLOGY

SUB UNIT A

1. Drug used in gastrointestinal disorders: Antacids, anti-secretary and antiulcer drugs, laxatives and antidiarrheal drugs, anti-emetics.

2.Drug acting on PNS and ANS: Adrenoceptor acting drugs, other sympathomimetics and sympatholytics, local anesthetic agents.

3. CNS pharmacology: Sedatives, hypnotics, General anesthetics, Anti-epileptic drugs, Drugs used in neurodegenerative disorders, narcotic analgesics.

4. Cardiovascular pharmacology: Anti-hypertensive drugs, anti-anginal agents, anti-arrhythmic drugs, management of myocardial infarction, drugs used in CHF, anti-hyperlipidemic drugs, diuretics, fibrinolytics and antiplatelet drugs, treatment of shock.

SUB UNIT B

5. Drugs used in respiratory diseases: Anti-asthmatic drugs, Mucolytics and nasal decongestants, anti-tussives and expectorants, pharmacotherapy of Asthma.

6. Drug used in endocrine disorders: antithyroid drugs, insulin, oral hypoglycemic agents, corticosteroids, oral contraceptives.

7. Autacoids & drug therapy in inflammation: Drugs acting on histamine and serotonin receptors, prostaglandins, thromboxanes and leukotrienes, analgesic, anti-pyretic, anti-inflammatory and anti-gout drugs.

8. Antimicrobial agents: Sulphonamides and co-trimoxazole, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolons, aminoglycosides, antitubercular agents, anti-fungal agents, anti-protozoal agents.

9. Drugs used in neoplastic diseases: chemotherapy of malignancy.

SUB UNIT C

10. Immunopharmacology: Hypersensitivity responses, immunosuppressants, drugs used in AIDS, systemic lupus erythematous and rheumatoid arthritis.

11. Pharmacovigilance: Adverse drug reaction (ADR), types of ADR, Mechanism of ADR. Drug interactions, Monitoring and reporting of ADR and its significance. Pharmacovigilance Program of India (PvPI), **ICH Guidelines for Pharmacovigilance.**

12. Preclinical Screening guidelines: Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals.

13. Toxicological methods: Study of acute, sub acute and chronic toxicity as per OECD guidelines (guidelines 420,423,425,407,408,451/452; only names and significance).

14. Clinical trials: Type and phases of clinical trials, placebo, ethical and regulatory issues including Good clinical practice in clinical trials.

UNIT 4

PHARMACOGNOSY

SUB UNIT A

1. Classification of crude drugs

Based on alphabetical, morphological, pharmacological, chemical, taxonomical and chemotaxonomic methods: organized and unorganized drugs: official and unofficial drugs.
Plants, animals and minerals: marine products: plant tissue culture.

2. Principles of plant classification

Diagnostic features and medicinal significance of important plants with special reference to:
Algae: Rhodophyceae (Agar, Alginic acid, Diatoms).
Fungi: Ergot, Yeast and penicillium.

3. Animal products

Biological sources, chemical constituents, adulterants and uses of: Shellac, cochineal, cantharides, woolfat, lard, beeswax, honey, musk, lanolin, gelatin.

4. Plant products

Introduction to plant bitters, sweeteners, nutraceuticals, cosmeceuticals and photosensitizing agents.

5. Enzymes

Biological sources, preparation, characters, and uses of: diastase, papain bromelain, ficin, yeast, pancreatin, urokinase, pepsin, trypsin, penicillinase, hyaluronidase and streptokinase.

SUB UNIT B

6. Biogenetic pathways
Formation of primary and secondary metabolites. Study of Calvin cycle, TCA cycle, Shikimic acid pathway, Embden-Mayerhoff pathway, acetate hypothesis, isoprenoid pathway. Biosynthesis of carbohydrates, lipids and volatile oils.

7. Carbohydrates & lipids
Biological sources, salient morphological features, chemical constituents, and uses of: Plantago, bael, chaulmoogra oil, neem oil, shark liver oil, cod liver oil, guggul lipids.

8. Tannins
Biological sources, morphology, chemical constituents, chemical test and uses of: Pale catechu, black catechu, nutgalls, *Terminalia belerica, Terminalia chebula, Terminalia arjuna.*

9. Volatile oils
Biological sources, morphology, chemical constituents, adulterants and uses of: Black pepper, turpentine, mentha, coriander, cardamom, cinnamon, cassia, lemon peel, orange peel, lemongrass, citronella, cumin, caraway, dill, spearmint, clove, anise, star anise, fennel, nutmeg, eucalyptus, chenopodium, ajowan, sandalwood.

10. Resinous drugs
Classification, formation, sources, chemical constituents, identification test, adulterants and uses of: benzoin, Peru balsam, tolu balsam, colophony, myrrh, asafoetida, jalap, colocynth, ginger, turmeric, capsicum, cannabis, podophyllum.

SUB UNIT C

11. Glycosides
Nature and classification. Biological sources, morphology, chemical constituents, adulterants and uses of: Digitalis, strophanthus, squill, thevetia, oleander, cascara, aloe, rhubarb, senna, quassia, dioscorea, quillaia, glycyrrhiza, ginseng, gentian, wild cherry, withania, bitter almond. Biosynthesis of cardiac and anthraquinone glycosides.

12. Alkaloids
Nature, classification, biological sources, morphology, chemical constituents, adulterants and uses of: Areca nut, belladonna, hyoscymous, stramonium, duboisea, coca, coffee, tea, cinchona, opium, ipecac, nux vomica, ergot, rauwolfia, vinca, kurchi, ephedra, colchicum,

vasaca, pilocarpus, aconite, *Solanum xanthocarpum.* Biosynthesis of tropane, cinchona and opium alkaloids.

13. Extraction and Isolation Techniques
General methods used for the extraction, isolation and identification of alkaloids, lipids, glycosides, flavonoids, saponins, volatile oils and resins. Application of column, paper and thin layer chromatographic techniques, for the isolation of phytopharmaceuticals.

14. Quality control and Standardization of herbal drugs

Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines-Extractive values, ash values, chromatographic techniques (TLC, HPTLC and HPLC) for determination of chromatographic markers. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations.

15. Ayurvedic system of medicine

Theory, basic concept, diagnosis, various branches of treatment in ayurveda, types of the drug formulation in Ayurveda and important Ayurvedic drugs and their uses, formulation of asavas, arishtas, watika, churna, tailas, ghruta, lep.

UNIT 5

SUB UNIT A

BIOTECHNOLOGY

1. Plant Cell and Tissue Culture

Structure of plant cell, DNA, Genes and chromosomes.

1. Cell and tissue culture : Requirements. Callus culture, suspension culture, batch culture. The concept of somatic hybridization, somatic embryogenesis.
2. Processes and applications,
   a. Isolation and immobilization of enzymes and plant cells and application.
   b. Protoplast and cell fusion.
   c. Germplasm conservation.
   d. Production of secondary metabolites by plant tissue culture.
   e. Gene transfer techniques.

2. Animal Cell Culture

Introduction to animal cell culture, medium used in ATC. Use of FCS, primary culture, secondary culture, cell line. Cloning: concept and application with technical hurdles. Transgenic animals as a source of food, organs and tissues, concept of xeno transplant.

3. Recombinant DNA Technology

Basic concepts, Introduction. Role of a restriction endonuclease, DNA ligase, DNA polymerase, Reverse transcriptase.

4. Process and Applications

- Constructing Recombinant DNA molecules. DNA Clones ,sources of DNA for cloning. DNA vectors, role of expression vectors, Host cell for recombinant work.
- Method for screening and selecting transformants. Expression of foreign genes. Uses of recombinant DNA.
- PCR and applications. Human gene therapy concept and applications.

- Drug delivery systems in gene therapy.
- Production and purification of recombinant proteins like, Insulin, Growth hormones, somatostatin, interferons, only examples of recombinant blood products.

MICROBIOLOGY

5. Microbial Assay
Importance, general methods of assay of antibiotics (Cup & plate method, paper disc method, turbidometry, dilution method), methods for fungicidal & antiviral compounds, assay, microbial limit tests.

SUB UNIT B

1. Bio-pharmaceutics
a. The fate of drug after drug absorption, various mechanisms for drug absorption, drug concentration in blood, biological factors in drug absorption, physicochemical factors, dosage form consideration for gastrointestinal absorption.

b. **Pharmacokinetics:** Compartmental models, Non-compartmental models, physiological models. Pharmacokinetics parameters - K_E, $t1/2$, Vd, AUC, Ka, Clt and CLR, their significance and application.

2. Bio-availability & Bio-equivalence
Physicochemical properties of drugs & added substances and its effect on preparations and biological availability of dosage forms. Pharmaceutical properties of dosage forms, disintegration, dissolution rate. Biological, pharmacological effects of dosage forms. Factors affecting Bioavailability, Determination of bioavailability.

Significance of bio-equivalence studies. Statistical analysis of bioequivalence studies.

Development, scale up & post approval changes [SUPAC] & *in vitro* [dissolution] *in vivo* [plasma concentration profile] correlation or IV/IV correlation (IVIVC). Multi stage - Bioequivalence studies. Therapeutic equivalence. Titration design for clinical rationales. New Drug Application [NDA].

SECTION C
PHARMACEUTICAL ENGINEERING

1. Evaporation
The basic concept of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, mathematical problems on evaporation.

2. Distillation
Raoult's law, phase diagram, volatility: simple steam and flash distillation, principles of

rectification, Mc-Cabe Thiele method for calculations of a number of theoretical plates, azeotropic and extractive distillation.

3.   Drying

Moisture content and mechanism of drying, the rate of drying and time of drying calculations, classifications and types of dryers, dryers used in pharmaceutical industries and special drying methods like freeze drying and lyophilization.

4.   Size reduction and size separation

Definition, objectives of size reduction, factors affecting size reduction, laws governing in energy and power requirement of a mill, types of mills including ball mill, hammer mill, fluid energy mill, micronizer, multi mill etc.

5.   Crystallization

Characteristics of crystals like purity, size, shape, geometry, habit, forms, size and factors affecting them. Solubility curves and calculation curves and calculations of heat balance around S Swanson's Walker crystallizer , supersaturation theory and its limitations, Nucleation mechanism, crystal growth.

RECOMMENDED STANDARD REFERENCE BOOKS

FOR PHARMACEUTICS and related subjects:

1. Pharmaceutics: Drug Delivery and Targeting, By Yvonne Perrie, Thomas Rades, Pharmaceutical Press, second edition.
2. Introduction to the Pharmaceutical Sciences, By Nita K. Pandit.
3. Aulton's Pharmaceutics: The Design and Manufacture of Medicines, edited by Michael E. Aulton, Kevin Taylor.
4. Remington: Essentials of Pharmaceutics, By Linda Ed Felton.
5. Pharmaceutical Dosage Forms and Drug Delivery, Second Edition, CRC Press, Pharmacy Education Series, by Ram I. Mahato, Ajit S. Narang.
6. Essentials of Physical Pharmacy, by CVS Subramanyam, Vallabh Prakashan.
7. Biopharmaceutics& Pharmacokinetics, D. M. Brahmankar.
8. Modern Pharmaceutics, Gilbert S. Banker and Christopher Rhodes.
9. Essentials of Physical Chemistry, B.S.Bahl, G.D.Tuli, S. Chand ltd. 2000.
10. Martin's Physical Pharmacy and Pharmaceutical Sciences, Patrick J. Sinko, Lippincott Williams & Wilkins, 2011
11. Textbook of Pharmaceutics, E.A. Rawlins, Ballière, Tindall, 1977
12. Handbook of Cosmetic Science and Technology, Third Edition
13. Martindale : The Complete Drug Reference: 36 th Ad.
14. Pharmaceutical Excipients
15. Developing Solid oral Dosage form: Pharmaceutical Theory & Practice
16. Pharmaceutical Preformulation and Formulatio, Mark Gibson
17. Foundation of Pharmacokinetics, Aldo Rescigno

18. Ansel,s Pharmaceutical Dosage Forms and Drug Delivery System, Allen, LV
19. Biopharmaceutics and Clinical Pharmacokinetics, Notari, RE
20. Cooper and Gunn's Tutorial Pharmacy, Carter, SJ
21. Biopharmaceutics and Pharmacokinetics, John Wagner, Drug Intelligence Publications, 1971.
22. Essentials of Physical Chemistry, B.S.Bahl, G.D.Tuli, S. Chand ltd. 2000.
23. Martin's Physical Pharmacy and Pharmaceutical Sciences, Patrick J. Sinko, Lippincott Williams & Wilkins, 2011
24. Textbook of Pharmaceutics, E.A. Rawlins, Ballière, Tindall, 1977

REFERENCE BOOKS FOR PHARMACEUTICAL CHEMISTRY/MEDICINAL CHEMISTRY:

1. Organic Chemistry – Morrison & Boyd, 4th edn, 2011 Pearson, New Delhi.
2. Organic Chemistry – I.L. Finar, Vol- I and Vol-II.
3. Wilson and Giswolds Text Book of Organic, Medicinal & Pharmaeutical Chemistry , 12th edn.Eds-J.M. Beale Jr, and J.H. Block , Lippincott Williams and Wilkins , 2013
4. Foye's Principle of medicinal Chemistry –Eds-Thomas Lemke,D.A.Williams, , Lippincott Williams & Wilkins, New Delhi.
5. Advanced Organic Chemistry, B.S. Bahl and Arun Bahl, S Chand and Company Ltd., Ram Nagar, New Delhi, 1st Edition.
6. Stereochemistry Conformation and mechanism by P.S. Kalsi, 5th Edition, New Age International Publishers, New Delhi.
7. Heterocyclic Chemistry, 3rd Edition, Raj K Bansal, New Age International Publishers, New Delhi.
8. Indian Pharmacopoeia all editions and volumes.
9. Advanced Organic Chemistry, Jerry March, Wiley, 1992.
10. Bentley and Driver's Textbook of Pharmaceutical Chemistry, Atherden, lm
11. Burger's Medicinal Chemistry, 6 vol, Abraham, DJ
12. Burger's Medicinal Chemistry and Drug Discovery, 5 vols set, Wolff, ME
13. Stereochemistry of organic compounds, Ernest Eliel, Wiley India.
14. A guide book to Reaction mechanism in organic chemistry-Peter Sykes
15. Reaction mechanism in organic chemistry- S M Mukherjee and S P Singh,MacMilan
16. Drug Design. Edited by E.J. Ariens -*Medicinal Chemistry; a Series of Monographs, V.11*
17. Drug design –Dr.V.M.Kulkarni and Dr.K.G.Bothara
18. Photochemistry and Pericyclic reactions by J. Singh
19. Pericyclic reactions-Ian Fleming
20. Pericyclic reactions -W .Carrurther

REFERENCE BOOKS FOR PHARMACEUTICAL ANALYSIS:

1. Indian Pharmacopoeia all editions and volumes
2. Instrumental Methods of Chemical Analysis (Analytical Chemistry) By. Dr. B.K. Sharma, Goel Publishing House, Meerut. 18th Edition (1999) (Part - Spectroscopy)
3. Instrumental Methods of Chemical Analysis (Analytical Chemistry) By. Dr. B.K. Sharma, Goel Publishing House, Meerut. 18th Edition (1999) (Part - Chromatography)
4. Instrumental Methods of Chemical Analysis (Analytical Chemistry) By. Dr. B.K. Sharma, Goel Publishing House, Meerut. 18th Edition (1999) (Part – Analytical Chemistry
5. INSTRUMENTAL METHODS OF ANALYSIS by H.H. Willard, L.L. Merrit and J.A. Dean
6. Introduction to Spectroscopy- D.L.Pavia,G.M.Lampman,G.S.Kriz
7. Principles of Instrumental analysis- Skoog, Holler, Crouch
8. Spectrometric Identification of Organic Compounds- **Silverstein**, R.M. and Webster, F.X., 6th ed., Wiley, New York, 1998
9. Applications of Absorption Spectroscopy of Organic Compounds- **John** R. **Dyer**, Prentice-Hall,
10. Instrumental methods of chemical analysis- H.Kaur, Pragati Prakashan

REFERENCE BOOKS FOR PATHOPHYSIOLOGY, PHARMACOLOGY:

1. RANG AND DALE'S Pharmacology, 7th Edition, M.M Dale, J.M Ritter, R.J Flower, G.Henderson H.P, Rang
2. Goodman & Gilman's the Pharmacological Basis of Therapeutics, Laurence L. Brunton
3. Basic & Clinical Pharmacology, Bertram G. Katzung, Susan B Masters, Anthony J Trevor
4. Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy, David E. Golan
5. Martindale: The Complete Drug Reference, Sean C. Sweetman
6. Goodman & Gilman's The Pharmacological Basis of Therapeutics
7. Color Atlas of Pharmacology, 3rd Edition, Heinz Lullmann, Klaus Mohr, Lutz Hein, Detlef Bieger, Thieme, Stuttgart. New York.
8. Lippincott's Illustrated Reviews: Pharmacology, 6th Edition, Springhouse publishers
9. Essential of Medical Pharmacology, KD Tripathi
10. Principles of Anatomy and Physiology, Gerard Tortora, 12th edition
11. Ross & Wilson, Anatomy and Physiology, 12th edition, Churchill Livingstone
12. Pharmacology and Pharmacotherapeutics –R.S.Satoskar, S.D. Bhandarkar , Popular Prakashan, Mumbai
13. Pharmacotherapy: A pathophysiologic Approach, by Joseph T. Dipirio, Robert L. Talbert, Gacy C. Yee, Gary R. Matzke, Barbara G. Wells, L. Micael Possey

REFERENCE BOOKS FOR PHARMACOGNOSY:

1. Textbook of Pharmacognosy, Thomas Edward Wallis, J & A Churchill ltd., London
2. Pharmacognosy, Tyler, 8th edition, Lea and Febiger, Philadelphia
3. Pharmacognosy 42nd Edition (Sep 2008), C.K. Kokate, A.P. Purohit, S.B. Gokhale (Nirali Prakashan)
4. Textbook of Pharmacognosy-Noel M Ferhuson
5. Textbook of Pharmacognosy-C.S.Shah and J.S.Qadry
6. Textbook of Pharmacognosy-H.W.Youngken
7. Textbook of Pharmacognosy and Phytochemistry-Dr.Biren Shah
8. Textbook of Pharmacognosy-T.N.Vasudevan, Kirti Laddha

REFERENCE BOOKS FOR BIOCHEMISTRY:
1. Lehninger's Principles of Biochemistry, David L. Nielson, Macmillan Learning, 2012
2. Harper's Illustrated Biochemistry, 28th edition, Robert Murray, David Bender, Mcgraw-hill, 2009

REFERENCE BOOKS FOR MICROBIOLOGY:
1. Microbiology, Michael Pelczar, 5th edition, Tat McGraw-Hill Publishing Company Ltd.

PET EXAMINATION SYLLABUS (EXTENSION EDUCATION)

Note;

1. Only 10 questions should be asked from each unit.
2. At least 3 questions should be asked from each sub unit.

UNIT 1ST

EDUCATION , EXTENSION AND HOME SCIENCE EXTENSION ;-

1. Meaning and definitions of education , concept ,need and types of education i.e. formal , informal and non-formal education.
2. meaning and definitions , origin, objectives, principles and fields of extension education and essential links in the chain of Rural Development.
3. Meaning , definitions, objectives ,scope ,fields of home science. Characteristics of home science in colleges and universities. Meaning , definitions, concept philosophy ,objectives and characteristics of Home science Extension .

UNIT 2nd

EXTENSION TEACHING -LEARNING PROCESS AND TEACHING METHODS

1. Definition of extension teaching, steps involved in extension teaching , factors contributing to extension teaching, principles of extension teaching , teaching plan, role of teacher in different levels , functions of teaching in extension education.
2. Definition of extension learning , laws of learning , ideal learning situation to achieve success. Factors affecting learning, learning experience, types of learning, psychological factors in adult learning.
3. Meaning , importance functions ,classification of extension teaching methods , factors to be considered in selection, preparation and use of extension teaching methods, interpersonal, group and mass approach and their techniques.

UNIT 3rd

COMMUNITY DEVELOPMENT , ORGANISATION, SOCIAL SURVEY AND RESEARCH :-

1. Meaning , definitions, objectives, limitations of community development, similarities and dissimilarities between community development and extension education. Difference between an extension worker and a community development worker
2. Definition and concept of community organisation, principles of community organisation, methods of community organisation
3. Definitions and importance of social survey and social research, types of social survey , variation between social survey and social research. tools of data collection- questionnaire, observation, interview and schedule methods.

UNIT 4th

EXTENSION PROGRAMME PLANNING, COORDINATION AND EVALUATION

1. Definition , importance , principles and steps involved in programme planning process, professional abilities needed by programme planners role of officials and non-officials in programme planning
2. Meaning, importance of coordination, necessity of team work , aspects of coordination, practical difficulties of team work and its solutions.
3. Meaning, definitions, importance of evaluation, types of evaluation, methods of evaluating extension programmes.

UNIT 5th

EXTENSION COMMUNICATION, TRAINING, ADMINISTRATION AND SUPERVISION

1. Meaning, definitions, functions, importance of effective communication , communication process, critical factors affecting communication process, importance of mass communication, barriers in mass communication, innovation decision process.
2. Meaning and importance of training , need of training, types of training for extension workers , principles of training.
3. Meaning of administration and supervision, concept, principles of good administration, necessity of administration, traits desirable in extension administrators and supervisors .

Rashtrasant Tukadoji Maharaj Nagpur University

Faculty- Science & Technology

Ph.D. Entrance Test

PET Syllabus, Section- B

Family Resource Management

(Home-Science)

UNIT 1-

- Management- Introduction, Definition, Basic concept of management, Function and Nature of management
- The management process – Definition, Importance & scope, Planning, Implementation, Evaluation feedback, Methods of evaluation, Principles of management
- Family Resources – Definition, Role & Scope of resources, classification-Human & Non-Human, Factors affecting on family resources, characteristics of resources
- Decision making- Definition & Importance, Process of Decision making, Types of Decisions, Methods of decision making, Techniques and tools for Decision making, Factors affecting decision making

UNIT- 2

- Time Management -Definition, Nature of importance of time, Tools of time management, Process of managing time
- Energy Management- Importance, Energy requirement for household tasks, Forms & effects of Fatigue, Fatigue-Types, Process of managing energy, Energy demands and stages of family cycle

- Work Simplification – Meaning, Definition, Techniques – Process chart, Operation Chart, Pathway Chart, Mundles classes of change
- Ergonomics- Meaning, Importance, Definition, Role & Scope of Ergonomics in home, Man-Machine – Environment system, Definition of Anthropometric, Anthropometric dimensions

UNIT -3

- Money Management- Concept of income, Planning-Importance of family budget, steps in making budget, Implementing, Evaluative feedback, Account Keeping
- Event Management- Importance, Definition, Planning, Implementation, Principles of Event management, Role of event manager, Qualities of a good event planners
- Entrepreneurship - Definition, concept, Characteristics of an entrepreneurship, Types of Entrepreneurs, Concept, Need and process in entrepreneurship development & Women entrepreneurship
- Consumer Protection, Role of standardization & labelling, Consumer movement in India, Consumer education & consumer forum

UNIT-4

- Concept & Development of Housing, Importance of Housing, Family Housing needs, Selection of site for house, Changes in housing needs & Standards
- Study of House plan, Principles of house planning, Factors affecting on House planning, Study of various rooms in the house
- Emerging concept in house planning – Rain water Harvesting, Solar Panels, Green Building, Low-cost housing

- Waste Management- Importance, Need, Classification of waste, Preparation of manure from household waste, House drainage, methods of house drainage, waste disposal, methods of waste disposal

UNIT-5

- Interior Decoration- Meaning, Importance, Characteristics of Interior Designer, Responsibilities of designer with client, Impact of Interior Design on Housing
- Selection of Furniture, Care of Furniture, Basic materials used for furniture, Application of art elements & Principles in arrangement, Multi-Functional Furniture
- Home Furnishing-Necessity, Types, selection of curtains, Types & Care of carpets & Rugs, Factors affecting the selection of Carpets & Rugs, Accessories in Interior
- Introduction & Definition of Landscaping, Importance of Landscaping, Principles of landscape gardening, Garden styles, Garden Furniture, Bonsai-History, Preparation of soil, selection of plants, care of Bonsai, Kitchen Garden

Ph. D. Entrance Test (PET)
Syllabus - 2021

FOOD SCIENCE AND NUTRITION
(Faculty of Science and Technology)

UNIT I

- **Carbohydrates, proteins & fats:** Definition, classification, structure, physical properties, digestion, absorption, transport, synthesis & degradation, food sources, deficiency states; Definition, types, sources & role of dietary fibre in prevention of diseases; Regulation of blood glucose- hypoglycemia, hyperglycemia, renal threshold & glucose tolerance test.

- **Nucleic acids:** Structure of a mononucleotide, Bases found in nucleic acids, Difference between RNA & DNA, functions & structures of DNAs & RNAs, mechanism of protein synthesis- transcription & translation.

- **Enzymes:** Classification according to IUB system, effect of temperature and pH on the activity of enzymes.

- **Vitamins & minerals:** Classification, functions, sources, recommended intake of fat soluble vitamins (vitamins A, D, E & K), water soluble vitamins (thiamine, riboflavin, niacin, pyridoxine, biotin, folic acid, cyanocobalamin & vitamin C), major minerals (calcium, phosphorous, iron & iodine) & trace elements (sodium, potassium, magnesium & zinc).

- **Water:** Functions of water in human body, water balance, sources of water, effect of dehydration and its prevention.

UNIT II

- **Methods of cooking:** Objectives & advantages of cooking foods, cooking methods and media, effect of different cooking methods on nutritive value of foods.

- **Food preservation:** Principles, importance, methods [high/low temperature (pasteurization/refrigeration/deep freezing), drying (sun drying/mechanical drying), radiation, preservatives; Food additives

- **Food fermentation:** Role of microorganisms as food fermenting agents for food products (idli, curd, butter, cheese & bread); Nutritive value of fermented foods.
- **Leavening agents:** Microbiological, chemical and natural leaveners.
- **Balanced diet & RDAs:** Definition, concept & factors affecting balanced diet, Definition, use & importance of RDAs in meal planning, RDAs for different food groups for various life stages, RDAs for different age groups & physiological conditions. Principles & advantages of meal planning, factors affecting meal planning, food fads & fallacies.
- **Nutrition during life cycles:;** Nutrition, dietary guidelines & diet planning during adulthood, pregnancy, (physiological changes, complications, during pregnancy), lactation (factors affecting milk secretion, galactogogue foods), infancy (growth and development, types of milk fed to infants, advantages of breast feeding, bottle feeding, weaning, supplementary foods), preschool & school going ages (growth and development, packed lunches), adolescence (growth and physical changes), old age (physical/ physiological changes occurring during ageing).

UNIT III

- **Introduction to diet therapy:** Application of principles of diet therapy, Diet counselling, Roles & responsibilities of dietician in health care, Dietetic care & its importance for hospital patients.
- **Therapeutic diets:** Adaptation & types (soft, bland, liquid, low & high fibre)
- **Nutritional support:** Special feeding methods (enteral & parenteral)
- **Etiology, classification, signs/symptoms, clinical determination/assessment, complications, nutritional management & lifestyle modification:** Underweight, obesity, peptic ulcer, diarrhea, constipation, ulcerative colitis, fever, anemia, gout, surgery, burns, & cancer.
- **Liver & gall bladder:** Functions of liver & gall bladder; Causes, classification, signs/symptoms, clinical determination/assessment, complications, nutritional management & lifestyle modification of viral hepatitis, cirrhosis of liver, hepatic coma, cholecystitis & cholelithiasis.

UNIT IV

- **Diabetes mellitus:** Etiology, classification, signs/symptoms, clinical determination /assessment, complications, nutritional management, drug treatment (oral hypoglycemic drugs and insulin) & lifestyle modification; Normal blood glucose level; Use of food exchange list in meal planning of diabetic people.

- **Hypertension:** Etiology, classification, signs/symptoms and principles of dietary management; Role of sodium/salt in hypertension.

- **Coronary heart diseases:** Etiology, classification, signs/symptoms, risk factors, nutritional management & lifestyle modification for atherosclerosis.

- **Renal Disorders:** Etiology, signs/symptoms & nutritional management for glomerulonephritis, nephrotic syndrome, acute and chronic renal failure & renal calculi; Importance of dialysis.

UNIT V

- **Assessment of nutritional status:** Methods of nutritional assessment-anthropometry, dietary, clinical & biochemical assessment.

- **Malnutrition:** Definition, types, causes & symptoms of under nutrition & over nutrition. Nutritional problems/consequences due to malnutrition. Prevalence of malnutrition in India. Role of national (ICAR, ICMR, NIN, CFTRI) & international organizations (FAO, WHO, UNICEF, CARE) in community nutrition & health.

- **Nutrition education:** Meaning, importance, objectives & methods of nutrition education; Evaluation of nutrition education outcome; National nutrition programmes [ICDS, MDM programme, national nutrition anemia prophylaxis programme (NNAPP), vitamin A prophylaxis programme (VAPP) & goiter control programme].

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Syllabus for PET Examination 2020-2021.

Subject: Human Development

S. N.	Units /Module No.	Sub-title of Unit	Contents of Units
1.	Unit I- Fundamentals of Human Development.	Human Development.	1. What is Human Development? Definition of HD, why do we need to study HD? 2. Brief history and interdisciplinary nature 3. HD as a scientific discipline. 4. Scope of the subject. 5. Opportunities for roles and employment - researcher : on issues related to HD - educationist : ranging from pre-school to University - planner of policies or programs related to child and family welfare implementing interventions for different aspects related to HD (include special educators, personnel in agencies catering to all age groups i.e. from crèches to old homes). 6. Settings available Early child hood care & Education – Creche, pre-school centres, day care centres, hobby centre, early stimulation programme ICDS – anganwadi. 7. Family & Child Welfare Programmes 8. Children with special needs.
		Growth & Development.	1. Meaning of growth & development, Principles of growth & development. 2. Domains of development. 3. Stages of development. 4. Context of development a) Genetic inheritance : introduction to genes and number of chromosomes, Genotype and Phenotype. b) Context of development: Family, SES, gender and culture (Bronfenbrenners contextual view). 5. Needs & Rights of children.
		Prenatal development.	1.Conception & stages, Factors influencing. 2.Complications / hazards during pregnancy. 3.Prenatal care, child birth. 4.At risk Babies. 5.Child friendly hospitals.
		Neonate.	1.Physical characteristics. 2.Abilities – Sensory & perceptual. 3.Adjustments & reflexes. 4.Care of the newborn. 5.Immunization.

2.	Unit II- Development in Early Years, Development in Childhood (2 to 12 Years) & Adolescence.	Introduction to the early years.	1. Significance of the early years. 2. Concept of developmental tasks & milestones. 3. Play - meaning and importance and types of play. 4. Infancy – Physical growth and development – body size, skeletal growth factors influencing and facilitating motor development.
		Infancy:- Socio – Emotional, Cognitive & Language Development.	1. Socio – emotional development – family, socialization, attachment, infant emotions, influences on social – emotional development. 2. Cognitive development – sensory motor development, factors influencing cognitive development 3. Language development – Language acquisition during infancy. 4. Factors influencing language development, facilitating language development.
		Childhood (2 to 12 Years):- Physical – motor & social – emotional development.	1. Development tasks of late childhood physical development – Changes in body size, nutrition and health, physical fitness. 2.Motors Skills, Factors influencing. 3.Changes in emotional development, understanding emotions and emotional self regulation. 4.Changes in self – concept, self understanding, development of self- esteem, industry vs inferiority 5.Relationships with family peers, teachers. 6.Influence of school and media.
		Childhood (2 to 12 Years): Cognitive and language.	1.Cognitive development - theoretical perspectives on cognitive development (Piagets and Vygotsky) factors influencing cognitive development. 2.Intelligence and creativity, influences on intelligence and creativity. 3.Development of language in late childhood, bilingualism / Multilingualism, influences on language development. 4.Moral development – Perspectives on morality, influences on moral reasoning and behaviour.
		Early adolescence / Puberty (12-16 Years).	1.Puberty – Sub stages of puberty, primary sex characteristics and secondary sex characteristics, effects of puberty changes. 2.Sex education. 3.Adolescence:- Development tasks and theoretical perspectives. 4.Physical and physiological changes .
		Adolescence: Cognitive, Language & Moral Development.	1.Perspective on cognitive development. 2.Development of intelligence and creativity. 3.Adolescent language. 4.Self and Identity at adolescence. 5.Family relationships – parents, grandparents & significant others. 6.Peer relationships.
3.		Introduction to Adulthood.	1. Concept and sub divisions of adulthood. 2. Adult roles and expectations in different cultures. 3. Diversity in adult life style.

	Unit III- Development in Adulthood.		Early Adulthood-1. Developmental tasks of early adulthood. 2. Physical changes. 3. Cognitive development. 4. Psycho-social development– self, identity, marriage and family, parenthood, work and gender relations.
		Middle Adulthood.	1. Physical development. Changing physiology and health. Adapting to physical changes, midlife changes/crisis, menopause in women, health concerns. 2. Cognitive development – attention, memory, cognitive skills in middle age, experience and expertise, adult intelligence. 3. Psycho-social changes-Issues of middle age-generativity vs. stagnation, concerns in middle age, career development and planning for retirement, civic roles and responsibilities.
		Late Adulthood.	1. Physical and physiological aspects of aging: health concerns; well-being and86 Disability. 2. Cognitive changes in late adulthood- understanding dementia and other concerns of the elderly. 3. Psycho-social development- adjustment to aging, changing economic situation, occupational continuity and change, Leisure and recreation, facing death. 4. Perspectives on death.
		Elderly in India.	1. Magnitude of elderly in India. 2. Problems of elderly. 3. Retirement homes. 4. Policies and Programmes for the elderly.
4.	Unit IV- Family Dynamics and Developmental Assessment.	Marriage.	1.Meaning and definition. 2.Marriage as an institution : goals, rituals, philosophy and functions. 3.Readiness for Marriage : Psychological, Social, Physiological and Economical. 4.Preparation for Marriage. 5.Selecting a suitable partner. 6.Premarital association. 7.Premarital guidance and counselling.
		Family.	1.Meaning definition and structure of family. 2.Changing trends in family constitution, roles, demand and responsibilities. 3.Nuclear and joint families - Structure, role, interaction and hierarchy of dominance in joint and nuclear families. 4.Influence of different disciplinary patterns, maternal deprivation, and overprotection in child development. 5.Areas of adjustment within the family at different stages of family life cycle. 6.Crisis in family life – unemployment, prolonged illness, death, separation, desertion, divorce, violence and distress and birth of handicapped child.
		Developmental assessment.	1.Definition, purpose and importance of assessment. 2.Developmental milestones– definition and developmental milestones of children from 0 to 6 years.

			3.Assessment below 2 years.
			4.Tools & techniques used for assessment- TDSC, DASII, DDST, DOC.
			5.Neurological evaluation.
			6.Assessment of visual & hearing impairment.
		Early Developmental Stimulation.	1.Definition, aims, importance.
			2.Role of parents.
			3.Newborn stimulation in NICU & at Home. 4.Sensory training, early stimulation programmes.
			5.Developmental delay – meaning and risk factor.
			6.Early intervention for the developmental delay.
5.	Unit V- Care and well-being in Human Development.	Care and Human Development.	1. Definition, concept and relevance of care.
			2. Vulnerable periods in life that require care.
			3. Principles of care giving.
			4. Holistic concept of well-being.
			5. Promoting well-being.
			6. Relationship between care and well-being.
			7. Subjective well being.
		Care and Well-being in Childhood.	1. Critical issues during infancy.
			2. Critical issues during early childhood years.
			3. Critical issues during middle childhood.
			4. Critical issues during adolescence.
			5. Health care; nutritional and psychological counselling.
		Care and Well-being in Adulthood.	1. Adults as caregivers and their needs.
			2. Experiencing wellness at different stages and work domains of adulthood.
			3. Care needs of elderly.
			4. Health and nutritional care.
			5. Spiritual and psychological well-being.
		Policies, Services and Programmes.	1. Community resources for well-being.
			2. Provisions and services that promote well-being.
			3. School health programmes.
			4. Counselling services for individuals and families

R.T.M. NAGPUR UNIVERSITY, NAGPUR

PET EXAM SYLLABUS (BASED ON UNDER-GRADUATE SYLLABUS)

Textile & clothing

UNIT I : Introduction to Textile Fiber

1. Classification of textile fibers, General and essential properties of textile fibers
2. Manufacturing process of natural fibers.;-Cotton, silk, wool ,Linen (Flex). Physical and chemical properties of natural fibres
3. Manufacturing process, of man made fibers viscose rayon, nylon, polyester Physical and chemical properties of man made fibres
4. Latest fibres :- Introduction and use of - Organic cotton, Soy, Metallic, Lycra (spandex)

UNIT II : Yarns and Fabric Construction

1. Types of Yarn – Simple, novelty, textured yarns.Yarn twist, Yarn Number
2. Spinning Process- Mechanical- Ring spinning, Open-end spinning.
3. Chemical spinning – Dry, wet, melt.
4. Methods of fabric contractions : Weaving, - handloom, its parts and opeation. Types of weaves, basic weaves, decorative weaves.-Dobby, Jacuard, pile, Swivel, Lappet

Unit III : Knitting and Finishes

1. Introduction to Knitting –Types of knitting, advantages and disadvantages of knitting,
2. Finishes, Importance of finishes : General finishes – Scouring, bleaching, singing, sizing, mercerizing, tentering, calendaring.
3. Special finishes: Special calendaring, napping, flame proofing, water proof and water repellency, wrinkle resistances.

UNIT IV: Textile Dyeing and Printing

1. Dyes : Classification, Natural and synthetic ,different types of dyes – direct, acid, basic, reactive, sulpher, vat, azo and natural dyes (vegetable, animal, mineral and mordents used) .
2. Dyeing- Introduction, classification, Methods of dyeing: stock, yarn, piece and union and cross dyeing ,garment dyeing ,Common dyeing defects
3. Styles of printing – Direct, Resist, Discharge
4. Methods of printing – Block, stencil, Roller, Screen, Digital, Flock

5. Regional embroidery : History, stitches, Motifs, colour, material , threads used in Kantha of Bengal, Chamba of Himachal Pradesh, Kasuti of Karnataka, Kashida of Kashmir. Phulkari of Panjab, Chikankary of Uttarpradesh, Manipuri from Manipur, Kathiyawadi of Gujrat

UNIT V : Fashion Design

1. Introduction to pattern making – Drafting, Flat pattern, Draping
2. Darts – Definition, Types of darts, dart manipulation, Methods of dart manipulation - Slash and Spread and Pivot method.
3. Pattern Grading – Defination, Methods of pattern grading – Nested, Track, computerized And vector. Principles of grading, terminology of grading.
4. Selection of dress design on the basis of elements of principles.
5. Factors affecting fitting, Fitting problems of bust, waist, hip, neck and shoulder and their remedies.
6. Definition of Fashion, Terminology of Fashion, Principles of Fashion. Theories of fashion adoption - Trickle-down theory, bottom up theory & trickle across theory
7. Classification of fashion, factors influencing fashion, Fashion cycle. Fashion leaders, Fashion Followers, Fashion Victims, Fashion Innovators, Fashion motivators.

Syllabus for Pet – II Examination

Name of Subject :- Cosmetic Technology

Faculty of Science and Technology Subject Code: 2.05

Unit -I   Skin Care Cosmetics: Introduction, formulations, properties, evaluation and advances in skin care products e.g. moisturizers, antiwrinkle preparations, skin whitening preparations, sunscreen preparations, makeup preparations and men's cosmetics.

Unit -II   Hair Care Cosmetics:Introduction, formulations, properties, evaluation and advances in Hair oils, shampoos, hair conditioners, hair dyes, hair colorants and hair tonics.

Unit – III   Cosmetic Microbiology: Significance of microbiological testing in cosmetics

A) Study of following microbiological processes; Sterilization, Disinfection, Determination of TMC, Determination of MIC
B) Study of Antiseptics, Sanitizers, Germicides, Antimicrobials, Preservatives.
C) Microbiological analysis of skin, hair, eye and baby cosmetics.

Unit – IV   Natural Cosmetics: Study of the following herbs with reference to their sources, Chemical constituents, evaluation, cosmetic uses and formulations: e.g. Aloe, Babool, Brahmi, Bawachhi, Chandan, Cucumber, Haldi, Ambahaldi, Jashtamadh, Jatamansi, Lodra, Mehandi, Neem Nagarmotha, Ritha, Radtachandan, Shikakai, Tulsi, Arnica, Manjishtha.

Unit – V   Plant Design: Selection of plant location, plant layout for manufacture of creams, powders, lotions, soaps and alcohol preparations.

Books Recommended:
1. Harry's Cosmetology.
2. Cosmetic Science and Technology by Sagarin E.
3. Microbialogy by Pelzer & Reed
4. Microbialogy by Sally.
5. Treas & Erans : Text Book of Pharmacognosy.
6. Claus & Tyler : Pharmacognosy.
7. Nadkarni : Meterial Medica
8. C.S.I.R.: Wealth of India
9. BIS specifications

Syllabus for Pet – II Examination

Name of Subject: Hotel Management & Catering Technology, Facutly of Home Science, Subject Code: 2.07

		Marks
Unit – I:	**Concept of Hospitality** • Growth, development and future of Hospitality Industry • Impact of socio-economics and technology on hospitality • Service quality in Accommodation and Front Office • Guest cycle : Reservation, Registration, cashier, telephones, guest history. • Housekeeping operations, laundry, uniform, linen.	16
Unit – II:	**Food and Beverage Management** • Menu planning from the perspective of concept, clarity, cost, price and efficiency. • Various types of licenses required by Food and Beverage outlets. • Renewal, suspension and termination of licenses, bar and liquor licenses, • Culinary history, the science of Gastronomy. • Indian and International cuisine (Thai, Mexican, Greek, Mediterranean etc.) • Quantity kitchen Management : Industry and Institutional. • Bakery and Confectionery. • Importance of food safety in Hotel Industry and HACCP, FSSAI regulations.	16
Unit – III:	**Sales and Marketing** • Sales – Definition, Importance, Objectives of Sales Promotion, • Factors contributing the growth of sales promotion. • Tools/levels of Sales promotion- Consumer sales promotion. • Personal Selling-Definition, Concept, Objectives, Importance. • Marketing – Marketing Environment • Marketing Planning – Meaning of Planning and Marketing Planning, Importance, Benefits and Characteristics of marketing Planning, • Marketing Segmentation-Basis and Criteria for Market Segmentation.	16
Unit – IV:	**Tourism** • Understanding Tourism, definitions • Importance scope and development of tourism • Emerging forms of tourism • Economic, Social, Environmental, effect of tourism • Travel agency and tour operators package tour and itinerary planning. • International Tourism	16
Unit – V:	**Food Costing and Food Cost Control** • Various practices of food cost control • Budgets and types of Budget • Budgetary control in hotels • Importance of budgetary control	16

Books Recommended :

1. Guest management, Dr. R.K. Singh; Aman Publications
2. Banquet Management and Room Divisions, Dr. D.K. Agarwal; Aman Publications.
3. Tourism and Hospitality Industry, Sunil Kabia; Reference Press New Delhi Financial & Cost Control Techniques in Hotel and Catering Industry, J. Negi.
4. Andrews S., Hotel Front Office Training Manual, Tata Publishing Company Limited 1982.
5. The Hospitality Industry: Significance and Application of HACCP, Dr. Nandita Sapra, Swaprakashan Publications.
6. Food safety in the Hospitality Industry – Tim Knowles
7. The Industrial Dispute Act 1947, Akalank publications
8. The Insurance Act 1938, Akalank publications
9. Industrial Dispute Act 1990, Central Law Agency.
10. Hospitality Marketing, Neil Wearne; global Books and Subscription Services
11. Professional Hospitality, Van Der Wagen; Global Books and Subscription Services
12. Tourism and Hospitality Industry, Sunil Kabia; Reference Press, New Delhi

RTM Nagpur University, Nagpur

Syllabus for PET (Ph.D. Entrance Test) Examination

mathematics

UNIT – I : Fundamentals of Mathematics (10 marks)

Matrices: Rank of matrix, Normal form, Solution of system of homogeneous and non-homogeneous linear equations, Eigen values, Eigen vectors, Cayley-Hamilton theorem.

Complex Numbers: De Moivre's theorem and its application. Roots of complex number, Euler's formula, Polynomial equations, The nth roots of unity, Inverse circular and hyperbolic functions, Logarithm of a complex quantity.

Laplace Transform and Fourier series: Laplace transform of elementary functions and its properties, Laplace Transform of derivatives and integrals, Convolution theorem, Fourier series.

UNIT – II: Calculus (10 marks)

Differential Calculus: Leibnitz's theorem, Maclaurin's and Taylor's theorems, Indeterminate forms, Functions of two variables, Limit and continuity of functions of two variables, Partial derivatives, Homogeneous functions, Jacobian and its properties, Taylor's theorem for a function of two variables, Maxima and Minima of function of two variables, Lagrange's multiplier method.

Integral Calculus: Reduction formulae, Integration of algebraic rational functions, Integration of trigonometric functions, Integration of irrational functions, Double integration, Triple integration and their applications, Beta and Gamma functions.

Vector Calculus: Vector differentiation, Gradient, Divergence and Curl, Line integral, Surface integral, Volume integral, Green's theorems in a plane, Gauss divergence theorem, Stokes' theorem and their applications.

UNIT –III: Differential Equations (10 marks)

Ordinary Differential Equations: Ordinary differential equations with constant and variable coefficients, First order exact differential equation, Integrating factor, First order linear differential equation and Bernoulli's differential equation, First order higher degree equations (solvable for x, y, p), Clairaut's form, Methods of solution of $dx/P=dy/Q=dz/R$, Pfaffian differential equation and its solution in three variables.

Higher Order Linear Differential Equations: Operator method to find particular integral, Euler's equi-dimensional equation, Method of variation of parameter.

Partial Differential Equations: Formation of partial differential equations (PDE), Lagrange's equation, Compatible system of first order equation, Charpit's method, Linear PDE of second order with constant coefficients, Homogeneous and Non-homogeneous linear PDE with constant coefficients, PDE reducible to equations with constant coefficients.

UNIT –IV: Algebra (10 marks)

Group and Ring Theory: Group, Subgroup, Normal sub-group and Quotient Group, Normalizer and Center of a group, Counting principle, Group homomorphism and automorphism. Rings, Special types of rings, Field, Integral domains, Ring homomorphism, Ideals and Quotient rings.

Vector Space: Vector space and sub-space, Linear span, Linear dependence and independence, Basis and Dimension, Inner product Space, Normed linear space, Orthogonal and orthonormal vectors.

Linear Transformations: Range, kernel, Rank and Nullity of linear transformation, Rank-Nullity Theorem, Inverse and composite of a linear transformations, Matrix of linear transformation, Linear operations in matrices, Rank and Nullity of a matrix, Orthogonal and Unitary matrices.

UNIT –V : Analysis (10 marks)

Sequences and Series: Sequences, Bounded and Monotone sequences, Convergent and Divergent sequences, Subsequences, Cauchy sequence, Convergent series, Cauchy criterion of convergence of a series, Geometric series and p-series, Comparison test, Ratio comparison test, Cauchy's root test, D'Alembert ratio test, Alternating series, Leibnitz's test, Absolute and conditional convergence.

Real Analysis: Existence and properties of Riemann-Stieltjes integral, Fundamental theorem of calculus, Countable and uncountable sets. Metric space, Open and Closed sets, Complete metric space, Compact Set, Connected set.

Complex Analysis: Analytic function, Cauchy-Riemann equations, Orthogonal curves, Harmonic function, Conjugate function, Constructions of analytic function.

Conformal transformation, linear, magnification, rotation, inversion, reflection and their combinations, Bilinear transformation. Complex integration, Cauchy integral theorem, Cauchy integral formula, Cauchy's inequality.

Reference Books

1. Matrix and Linear Algebra, by K. B. Datta , Prentice Hall of India Pvt. Ltd., New Delhi-2000

2. Matrices by Ayres Jr. Frank, Schaum's Outline Series, Mcgraw Hill Book Company, Singapore, 1983

3. Complex Variables, by Spiegel M. R., Scaum's Outline Series, McGraw- Hill, 1981

4. Plane Trigonometry(Part II) by S.L.Loney, S. Chand & Co. Ltd.,New Delhi

5. Integral Transforms by Goel& Gupta, PragatiPrakashan, Meerut, 2001

6. Advanced Engineering Mathematics by Erwin Kreyzig, John Willey and Son's, Inc. New York, 1999

7. Calculus by Ayres F. Jr.Schaum's Outline Series, McGraw- Hill, 1981

8. Differential calculus by Shanti Narayan and Dr P. K. Mittal, S. Chand & Co. Ltd, New Delhi, 2014

9. Integral Calculus by Shanti Narayan and P. K. Mittal, S. Chand & Co. Ltd, New Delhi, 2005

10. Theory and problems of Vector Analysis by Murray R Spiegel,Schaum's outline series, McGraw-Hill Book Company, New York, 1974

11. Ordinary and Partial Differential Equations (Paperback), by Dr. M.D.Raisinghania: S. Chand & Co. Ltd., New Delhi

12. Ordinary and Partial Differential Equations (Theory and Applications) by Nita H. Shah, PHI, 2010

13. Advanced Engineering Mathematics by H. K. Das, S. Chand and Co. ltd, New Delhi, 2009

14. Elements of Partial Differential Equations by IAN N. Sneddon, McGraw- Hill Book Company, 1986

15. Topics in Algebra by I. N. Herstein, Wiley Eastern Ltd. (second edition) 1992

16. An Introduction to Linear Algebra by V Krishnamurthy, V P Mainra and J L Arora, Affiliated East West Press Pvt. Ltd,1976

17. A Text Book of Modern Abstract Algebra by Shanti Narayan, S. Chand and Co. Ltd., New Delhi

18. An Introduction to Real Analysis by P K Jain and S K Kaushik, S. Chand & Co. Ltd. New Delhi,2000

19. Principles of Mathematical Analysis (Third Edition) by Walter Rudin, McGraw-Hill International Edition,1976

20. Functions of a Complex Variable by Goyal& Gupta, PragatiPrakashan,2010

21. Theory of Complex Variables by Shanti Narayan, S. Chand & Co. Ltd., New Delhi

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PROPOSED SYLLABUS FOR PET EXAMINATION: CHEMISTRY

(2021 ONWARDS)

UNIT 1: STRUCTURE, BONDING, PERIODIC PROPERTIES, COORDINATION CHEMISTRY

A] Valance bond theory approach and hybridization in various inorganic and organic molecules. VSEPR theory and prediction of structures of molecules and ions. MO approach to explain bond order and magnetic characters of diatomic molecules.

B] Ionic bonding, polarizability and polarization power, effect of polarization on physical properties of molecules. Periodic variation of atomic radii, ionization potential, electron affinity, electronegativity and metallic character in modern periodic table.

C] Coordination compounds and their properties. IUPAC nomenclature of coordination compounds.Chelates and their stability.Werner's theory of coordination.Structures of complexes based on valence bond theory. Sidgwick's EAN concept.Limitations of valence bond theory of complexes, Crystal field theory for octahedral, tetrahedral and square planar complexes.Explanation of magnetic properties of complexes based on VBT and CFT.Explanation of colours of complexes based on CFT.Isomerism in complexes.

UNIT 2: FUNDAMENTALS OF ORGANIC CHEMISTRY, STEREOCHEMISTRY OF ORGANIC COMPOUND

A] Elementary ideas of inductive, electromeric and mesomericeffects. Hyperconjugation. Homolytic and heterolytic bond fission. Electrophiles and nucleophiles. Types of organic reactions. Reactive intermediates: carbocations, carbanions, free radicals, carbenes, nitrenes (their formation, geometry, orbital structure and stability).

B] Structures (including hybridization) and characteristicreactions of alkanes, alkenes, alkynes, dienes, aromatic compounds, alkyl halides, aldehydes, ketones, carboxylic acids, ethers, esters, alcohols, phenols, amines and amides. Aromaticity.Aromatic electrophilic substitution and orientation of substituents.

C] Isomerism and its types. Optical isomerism-elements of symmetry, molecular chirality.Enantiomers.Stereogenic centre. Optical activity.Chiral and achiral molecules with two stereogenic centres.Diastereomers, mesocompounds and racemic mixtures. Resolution of enantiomers by biological and chemical methods.Inversion, retention and racemization. D] Asymmetric synthesis. Relative and absolute configuration.Sequence rules- *D/L* and *R/S* system of nomenclature. Geometrical isomerism: *cis-trans* and *E-Z* systems of nomenclature.Geometric isomerism in maleic acid, fumaric acid, 2-butene etc. Conformational analysis of ethane and n-butane.Difference between configuration and conformation

UNIT 3: THERMODYNAMICS AND ELECTROCHEMISTRY, CHEMICAL KINETICS, ADSORPTION AND CATALYSIS

A] Thermodynamic systems and their types. Intensive and extensive properties. State functions and path functions. Reversible and irreversible processes. Concept of heat, work and maximum work. Types of thermodynamic processes. Enthalpy, entropy, Gibbs free energy, their interrelations and physical significance. Spontaneity of process in terms of entropy change and free energy change. Heat capacities at constant pressure and constant volume vant Hoff reaction isotherm and effect of temperature on equilibrium constant (isochore). Enthalpy changes accompanying chemical reactions.

B] Conductance and its measurement. Specific, equivalent and molar conductance Kohlrausch law and its applications. Conductometric titrations. Electrode potentials and concentration dependence (Nernst equation). Reference and indicator electrodes. Buffer solutions.Potentiometric and pH-metric titrations

C] Order and molecularity of reaction. Rate constants of zero, first and second order reactions. Halflife period of zero, first and second order reactions. Pseudo-unimolecular reaction. Temperature dependence of reaction rates and Arrhenius equation. Physical and chemical adsorption. Adsorption Isotherms: Freundlich, Langmuir and B.E.T. isotherms with their physical significance. Application of B.E.T. equation in determination of surface area of adsorbent. Catalysts, promotors, catalytic poisons, homogeneous and heterogeneous catalysis, enzyme catalysis.

UNIT 4: FUNDAMENTALS OF CHEMICAL ANALYSIS

A] Concept and application of statistical parameters like mean, median, average deviation, standard deviation, coefficient of variation, correlation coefficient, uncertainities in estimation, errors and their types. Significant figures and calculations involving them..

B] F-test, t-test and Q-test for data interpretation. Primary standards and secondary standards. Calculations involved in standard solution preparation and standardization of solutions. Solubility and solubility product.

C] Fundamentals of volumetric and gravimetric analysis. Theories of indicators in various types of titrations. Principles and applications of paper, thin layer and column chromatography, ion exchange and solvent extraction.

UNIT 5: CHARACTERIZATION TECHNIQUES

A] Principles and selection rules in spectrophotometry, microwaves spectroscopy, IR spectroscopy, NMR spectroscopy and Raman spectroscopy. Numerical problems based on Beer's law and electronic transitions in atoms and molecules.

B] Application of microwave spectroscopy for bondlength determination including numerical problems. Application of IR spectroscopy in functional group detection. Prediction and interpretation of NMR spectra of simple organic compounds. Complementary nature of Raman spectroscopy and IR spectroscopy and its applications.

C] Fundamentals of photochemistry: spin states, fluorescence, phosphorescence, chemiluminescence and photosensitization.

Syllabus for PET
Section B
Subject : Physics Aptitude
Faculty : Science and Technology

Unit I: Heat and Thermodynamics, Statistical Physics and Electrodynamics :

Mean free path, Transport Phenomena, Viscosity of Gases, Thermal Conductivity ofGases, Diffusion, Inter relation between three transport coefficients, Zeroth Law of Thermodynamics, First Law of Thermodynamics, Relation connecting P,V and T in anAdiabatic Process, Second Law of Thermodynamics ,Carnot's cycle, Carnot's Engineand its efficiency, Carnot's Theorem, Entropy changes of a Closed System during anIrreversible Process, Entropy, Third Law of Thermodynamics, Maxwell's Thermodynamical Relations, T-ds equations, Clausius- Clapeyron latent heat equations,Internal energy, Helmholtz' function, Enthalpy, Gibb's function. Maxwell-Boltzmann , Bose-Einstein and Fermi-Dirac statistics, Distribution function , Fermi energy, Fermi Temperature.

Maxwell's equations and their physical significance, Poyinting theorem, Equation of continuity , Electromagnetic wave equation.

Unit II: Optics:

Cardinal Points of an Optical System(six points), Coaxial Lens System (equivalent focal length and cardinal points), Huygen's Eyepiece, Ramsden's Eyepiece and their cardinal points. Interference in thin film, Newton's Rings, Determination of wavelength of Sodium light, Michelson Interferometer, Determination of wavelength ofmonochromatic light, Fresnel and Fraunhouffer diffraction, Plane diffraction grating, Determination of wavelength of Sodium light, Rayleighcriterion, Resolving power of grating, Resolving power of Prism. Polarization by Reflection, Brewster's law, Malu's law, Double refraction, Nicol prism, Nicol prism as analyzer, Huygen's explanation of double Refraction in Uniaxial crystals , Optic axis inthe plane and inclined to the crystal surface, Elliptically and Circularly polarized light,Quarter wave plate, Half wave plate, Properties of Lasers, Intensity, Monochromaticity, Directionality and coherence, Einstein's coefficients, Temporal and spatial coherence, Coherence of the field and sizeof the source, Coherence and monochromaticity, Shape and width of spectral lines, Linebroadening mechanism,Basic principles of lasers, population inversion, Laser pumping, Two level and three level pumping, **Ruby laser**, Three level system, **He-Ne lasers:** Energy level diagram, construction and salient features of He-Ne laser device, Semiconductor laser.

Fibre optics- Importance of optical fibre , Propagation of light waves in optical fibre, Basic structure, Stepped index monomode fibre, Graded index fibre, Acceptance angle and acceptance cone, Numerical aperture, Fibre losses and their units (basic concept), Electrical and optical band width, bandwidth length product, Dispersion in optical fibre.

Unit III: Solid State Physics and electronics:

Bravais lattices, Reciprocal lattice, diffraction and the structure factor; Drude-Lorentz theory, Thermal conductivity, Electrical conductivity, Sommerfield Model, Fermi Dirac Distribution, Quantum theory of free electron in a box,Free electron concentration, Electronic specific Heat, Explanation of Diamagnetism, Paramagnetism, ferromagnetism, ferrimagnetism, Anti- ferromagnetism, Specific heat of solids, Classicaltheory of Lattice heat Capacity, Debye'stheory of specific heat of solids, Debye continuum Model, Limitations of Debye model, Energy bands in solids, Intrinsic and Extrinsic Semiconductor, improved model of aninsulator and Intrinsic Semiconductors, Model for impurity semiconductors, n-typesemiconductors, P- type semiconductors. Donor Level, Acceptor level, P-N junction theory,

Nanoscience and nanotechnology, Quantum structures, Nanoclusters, organic nanocrystals. metal colloids, Nanoclusters, nanotubes, nanowires, nanorods, nanocrystalline materials, Physical Methods - Thermal evaporation methods: Resistiveheating, Laser evaporation, Arcevaporation, Sputtering process: Glow discharge, DC sputtering, Magnetron sputtering Ion beam, Methods offilm, preparation, laser CVD, Photochemical CVD, Plasma enhanced CVD, Chemicalbath deposition: ionic and solubility products, Electrode position: Deposition mechanism and preparation of compound thin filmSpray pyrolysis: Deposition mechanism and preparation of compound thin Films, sol-gel combustion, coprecipitation technique, wet chemical technique. Operational amplifier, application of Opamp (Linear and nonlinear)

Unit IV : Atomic Molecular Physics, Nuclear & Particle Physics:

The Vector Atom Model, Quantum numbers associatedwith the vector atom model, LS and J-J coupling, The Pauli's exclusion Principle,Selection rules, Intensity rules, Interval rule, Normal Zeeman effect, Anomalous Zeemaneffect, Stark effect.Electromagnetic Spectra, Classification of Molecular Spectra, Theory of pure rotationalspectra, Theory of rotation-vibration spectra, Raman Effect, Experimental study, RamanEffect in solids, liquids and gases, Proton Electron Hypothesis, Nuclear transmutation and Discovery of Neutron, Proton-neutronhypothesis to Nuclear forces, Nuclear Binding energy, Shell model, Liquid DropModel and Semi-Empirical Binding energy formula, Geiger Muller counter, Proportionalcounter, Wilson Cloud Chamber, Ionization chamber, Linear accelerator, Cyclotron, Synchrocyclotron.

Nuclear size & its determination, nuclear radii by Rutherford scattering, electronscattering, nuclear quantum numbers, angular Momentum,nuclear dipole moment, electric quadruple moment, Interaction of charged particles, scintillation detector, semiconductordetector. Elements of two body problem, charge independence & charge symmetry ofnuclear forces, Fermigas model. Radioactive decay, laws of successive transformation, fission & fusion, β – decay, three forms of β- decay, Fermi theory of β-decay,Weak, strong &electromagnetic interaction, classification of elementary particles, conservation laws,

Unit V: Classical Mechanics, Quantum Mechanics and Electrodynamics:

Constraints, classification of constrains, Principle of virtual, De'Abembert's principle and its application, Generalized coordinates, Newtonian mechanics for many particle system,conservation laws, work energy theorem, Lagrangian equation of motion, Variation techniques, Kinetic energy in terms ofgeneralized coordinates, Theorem on total energy, Generalized momentum cycliccoordinates, Integrals of motions, Concept of symmetry, Invariance under Galilean transformation, Variational principal, Two body problem, The equation of motion andfirst integral, Equation of orbit, Rutherford scattering, Differentials scattering cross section,Rutherford's formula viral theorem, Principal of least actions, derivation of equations ofmotions, variation and end points, Hamilton's principle, and characteristic, Hamilton Jacobi equation, Canonical transformation, generating function condition for canonicaltransformation problems.

Introduction, Photoelectric Effect, X-rays, X-ray diffraction , Quantum Theory of Light,The Compton Effect, de Broglie waves, Wave function, de Broglie Wave Velocity, Waveand Group velocities, G. P. Thomson's experiment, The Uncertainty principle and itsapplications, The Wave Particle Duality, Schrödinger's Equation: Time dependent form,Probability current, Expectation Values, Operators, Schrödinger's Equation: Steady-state form, Eigen values and Eigen functions,The particle in a box :energy quantization, Theparticle in a box, wave functions, The particle in a box, TheHarmonic Oscillator, The Harmonic Oscillator-Energy level, The particle in a threedimensional box, Schrödinger's equation for the Hydrogen Atom, Quantum numbers –Total quantum number, Orbital quantum number, Magnetic quantum number.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

SYLLABUS FOR Ph. D. ENTERANCE TEST (PET)

SUBJECT: BOTANY

SECTION B

UNIT I: MICROORGANISMS AND LOWER CRYPTOGAMS:

1. **Viruses, Mycoplasma and Bacteria:** General characteristics, structure and economic importance.
2. **Cyanobacteria and Algae:** General characteristics, structural aspects, economic importance with reference to agricultural and ecological aspects.
3. **Biofertilizers and Mushroom Cultivation:** Commercial applications, ecological implications and recent trends in research.
4. **Fungi and Plant pathology:** General characteristics and economic importance of fungi; Causative agents, symptoms and control measures of diseases in cereals and pulses.
5. **Bryophytes:** General characteristics; alternation of generation; evolution of sporophyte (progressive and retrogressive theory); economic importance.

UNIT II: PALAEOBOTANY, TRACHEOPHYTES AND ECOLOGY:

1. **Palaeobotany:** Geological time scale, fossilization process and types of fossils.
2. **Pteridophytes:** General characteristics, types of stele and stelar evolution; heterospory and seed habit.
3. **Gymnosperms:** General characteristics, phylogeny and economic importance.
4. **Angiosperms:** Origin of angiosperms and Phylogeny; ICBN; Systems of Classification (Bentham and Hooker, Engler and Prantl and Hutchinson); Modern trends in taxonomy (Cytotaxonomy, Phytochemistry and Molecular taxonomy).
5. **Ecology:** Soil: Profile and chemical and physical properties; Community ecology: methods to study plant communities; qualitative and synthetic characters; Pollution: Types, causes and control measures; environmental impact assessment (EIA).

UNIT III: PLANT PHYSIOLOGY AND BIOCHEMISTRY:

1. **Water relation and mineral nutrition:** Osmosis; ascent of sap; transpiration; Mineral nutrition: role, deficiency symptoms and remedy for deficiency of N,P,K, Zn, Bo, Mg, S and Fe.
2. **Photosynthesis and Respiration:** Photosynthesis: Photoposphorylation and Carbon assimilation; Respiration: Glycolysis, Kreb's cycle and Oxidative phosphorylation; Regulation of and factors affecting photosynthesis and respiration.
3. **Plant hormones:** Structure and functions of Auxins, Cytokinins, Gibberelines, ABA, Ethylene and Brassinosteroids.
4. **Biochemistry:** Macromolecules: Structure, classification and functions of carbohydrates, lipids and proteins; Enzymology: Structure and properties of enzymes, mode of action, regulation of enzyme action and factors affecting enzyme action.

5. **Metabolic pathways:** Biological nitrogen fixation; nucleotide and phenylpropanoid metabolisms.

UNIT IV: CYTOLOGY, GENETICS AND CELL BIOLOGY

1. **Chromosome morphology and its organization:** Structural and molecular organization; karyotyping; Structural and numerical variations: Types, their consequences on cell division and phenotypic expression, applications in plant improvement.
2. **Cell divisions in plants:** Mitosis, meiosis and their molecular aspects with reference to mitotic spindle and regulation of cell cycle.
3. **Genetics and plant breeding:** Genetics: Gene interactions; genetic mapping using three point cross; Hardy-Weinberg equilibrium and factors affecting the equilibrium; Epigenetics; Plant Breeding: Objectives, Methods (Selection and Hybridization); Cytoplasmic male sterility.
4. **Mutation and Biostatistics:** Types of mutations, types and applications of mutagens; mechanism of DNA damage and repair; Measures of central tendency (Mean, median and mode); Standard deviation, Standard error, Chi-square test, Student's t-test.
5. **Cell Biology:** Structural aspects in prokaryotic and eukaryotic cells; Ultrastructure and functions of plasma membrane (Fluid mosaic model), nucleus, mitochondria, chloroplast and ribosomes (70S and 80S).

UNIT V: MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY:

1. **Nucleic acids:** Structure of DNA and RNAs; DNA replication and its regulation in prokaryotes and eukaryotes; methods of gene sequencing and gene synthesis.
2. **Genes:** Structure and functions; gene expression (Transcription and translation, RNA splicing); Gene regulation: lac operon model, trp operon model, gene amplification, role of promoter in gene regulation and RNAi.
3. **Plant Development and Stress Biology:** Molecular organization of RAM and SAM; Molecular aspects of embryology (Pollen and embryo development); Biotic stress (Passive and active mechanisms, Hypersensitive response, systemic acquired resistance and phytoalexins); Abiotic stress (Types and mechanisms to overcome the stress).
4. **Plant Tissue Culture:** Methods of sterilization; tissue culture media; Methods of tissue culture (Callus culture, Cell culture, Protoplast culture, Organ culture, Androgensis, Gyanogenesis, Endosperm culture, Embryo culture and Somatic embryogenesis); applications of tissue culture.
5. **Genetic Engineering:** Tools in genetic engineering: Enzymes (Restriction enzymes, Ligases, DNA-polymerase, reverse transcriptase and nucleases); Vectors (Plasmid, Phage, Hybrid vectors and artificial chromosomes); Marker genes; Techniques (Electrophoresis, Southern, Northern and Western blotting,); Methods of gene transfer in plants: Indirect: *Agrobacterium* mediated; Direct: Electroporation and Liposome mediated; applications of genetic engineering in plant improvement.

PET syllabus of Zoology

Unit I: Nonchordata and Chordata

1. Mode of infection and control of Parasitic Protozoan of Man :*Entamoeba, Trypanosoma, Giardia and Leishmania,* parasitic adaptations in helminthes.

2. Insect vectors and their control: Mosquito, Housefly and Sand fly; Moulting and metamorphosis in insects.

3. Life cycle and economic importance of honey bee, silk worm and lac insect, Prawn culture and pearl culture.

4. Characters of Chondrichthyes and osteichthyes; Fish farming: Construction and maintenance of fish farm, fish breeding, types of fish culture

5. Parental care in amphibia, poison apparatus and biting mechanism in snake, venom, migration of birds, Flight adaptation in birds, General character of Prototheria, Metatheria and Eutheria

Unit II: Cytology, Molecular biology, Genetics and Immunology

1. Structure and functions of prokaryotic and eukaryotic cells and their organelles, organization of bio-membranes and mechanism of transport.

2. Checkpoints of Cell cycle, cell death, apoptosis and cancer, DNA replication, protein synthesis.

3. Chromosomal aberrations, Gene mutations and mutagenic agents; Differential action of genes: DNA amplification, PCR, RAPD, Lac operon and tryptophan operon; Gene interactions-linkage, crossing over, mutations.

4. Cells and organs of immune system, types of immunity, Response of B and T cells, cytokines and complement system.

5. Structure and types of antigens and antibodies, Precipitation and agglutination, Autoimmune diseases and their treatment.

Unit III Developmental Biology, Physiology and Endocrinology

1. Development of fish, frog, chick and mammal with reference to post fertilization changes, causes of infertility in humans, hormonal and mechanical contraceptives, In Vitro Fertilization, stem cells.

2. Enzyme kinetics: Concept of Enzyme catalysis, Derivation of Michaelis- Menten equation, Concept of Km and Vmax, Lineweaver-Burk Plot; factors affecting enzyme activity

3. Digestive glands';Gastro-intestinal hormones; Digestion of proteins, carbohydrates and lipids; Respiratory pigments, Mechanism of respiration; blood clotting mechanism; cardiac cycle; ECG.

4. Ultra structure of neuron, Conduction of nerve impulse, sliding filament theory of muscle contraction; Mechanism of Urine formation, Mechanism of dialysis.

5. Endocrine glands in vertebrates: Pituitary, thyroid, parathyroid, Adrenal, Pineal and gonads- structure, hormones and functions; role of pheromones in reproductive behavior.

IV Environmental Biology and biodiversity

1. Major zones of atmosphere , composition of air, global distribution of water , Physico-chemical characteristics of water, formation of soil

2. Food chain, food web and ecological pyramids

3. Causes of reduction and methods of biodiversity conservation, hot spots of biodiversity in India, Endangered species of butterflies, dragonflies, amphibians, reptiles, birds and mammals

4. Wildlife conservation act 1972; Zoological survey of India: formation and role in animal conservation.

5. Bioaccumulation, biomagnifications, Water, air, noise, space pollution.

V- Biotechniques, Biotechnology, Bioinformatics, Biostatistics

1. , Microtechnique: Fixation of tissue, paraffin embedding and block making, section cutting and HE staining. Histochemical staining techniques for carbohydrates, proteins and lipids.

2. Techniques of sterilization, centrifugation, colorimetry, Agarose Gel electrophoresis and SDS-PAGE.

3. DNA fingerprinting , Gene isolation methods, DNA manipulation enzymes, cloning vectors.

4. Bioinformatics: databases and their types

5. Biostatistics – Tabulation and presentation of data, sampling errors, mean, mode, median, probability, standard deviation, standard error.

Syllabus for Pet Examination (Subject Aptitude)
Name of Subject: Geology,
Faculty of Science and Technology, Subject Code: 8.05

Unit	Title (Subject Aptitude)
Unit 1	Introduction to Geology, Mineralogy, Physical Geology and General Geology
Unit 2	Optical Mineralogy and Crystallography, Igneous Petrology
Unit 3	Sedimentary and Metamorphic Petrology, Palaeontology
Unit 4	Structural Geology, Economic Geology, Indian Stratigraphy
Unit 5	Elements of Remote Sensing and Environmental Geology, Elementary Hydrogeology and Geomorphology

Unit I (Introduction to Geology, Mineralogy, Physical Geology and General Geology)

Earth as a member of solar system; gross features of the Earth; brief idea about core, mantle, crust; convection in Earths' core and production of its magnetic field; earthquakes and volcanoes; origin of the Earth; internal structure and chemical composition of various layers; application of geophysics in understanding dynamics of the Earth; concept and theory of Isostasy; continental drift.

Mineral composition of the earth's crust; chemistry of minerals (polymorphism, isomorphism and pseudomorphism); various physical properties of the minerals; properties dependent on magnetism, electricity and radioactivity; silicate structures; rock forming minerals- silicates, oxides and sulphides; chemical, and physical properties and the geological occurrences of the following mineral groups: olivine, garnet, aluminous silicates; quartz, feldspar, feldpathoids, zeolites, pyroxenes, amphiboles and micas.

Rock weathering and erosion; geological work done by wind, river, underground water, glaciers and oceans; brief idea about soil, formation and types of soil; earth movements: diastrophism (orogeny and epeirogeny); definition and types of geosynclines; mountain building process and types of mountains; evolution of continents and oceans; theory of plate tectonics, nature and types of plate margins, sea-floor spreading; origin and significance of mid-oceanic ridges and trenches; origin and distribution of island arcs.

Unit II (Optical Mineralogy and Crystallography, Igneous Petrology)

Elementary ideas about mineral optics, critical angle, refractive index, twinkling, birefringence, pleochroism, interference colours, extinction and extinction angle, twinning, isotropism and anisotropism, phenomenon of double- refraction and nicol prism; optical characters of the following rock forming minerals in ordinary and plane polarized light: Quartz, microcline, orthoclase, muscovite, biotite, hornblende, hypersthene, augite, olivine, garnet, calcite, kyanite, sillimanite, tourmaline, epidote, tremolite and actinolite; laws of crystallography, constancy of interfacial angle, rationality of indices and symmetry; crystal structure, crystal faces, edges, solid angles and zone, crystallographic axes and axial angles, crystal systems and classification of crystals into six systems, classes of symmetry.

Rock cycle; forms of igneous rocks, textures and structures of igneous rocks, classification of igneous rocks; magma - definition, composition and origin, formation of igneous rocks; phase rule and phase equilibrium; crystallization of unicomponent magma; mineralogical characteristics of various igneous rocks; crystallisation of bicomponent silicate magma; Bowen's reaction series; magmatic differentiation and assimilation.

Unit III (Sedimentary and Metamorphic Petrology, Palaeontology)

Sediment - weathering, transportation, deposition, consolidation, lithification and diagenesis; sedimentary textures; primary features and mineralogy of sedimentary rocks; classification of sedimentary rocks; residual, clastic, chemical and organic sedimentary deposits; concept of sedimentary facies. agents, kinds, and products of metamorphism; textures, structures and classification of metamorphic rocks; basic concepts about zones, facies and grades of metamorphism; metamorphism of pelitic, acidic, basic, and calcareous rocks; metasomatism, granitisation and migmatisation.

Processes of fossilization; preservation potential of organisms; elementary ideas about origin of life; evolution and fossil record; application of palaeontological data in economic geology, palaeoecology, evolution, stratigraphy, palaeogeographic and palaeoclimatic reconstructions; basic ideas about micropalaeontology and microfossils; classification, diagnostic morphological characters of Brachiopoda, Mollusca (Bivalvia, gastropoda and

cephalopoda); classification, diagnostic morphological characters of Foraminifera, Graptoloidea and Anthozoa; classification, diagnostic morphological characters, environment of the following- Echinoidea and Trilobita; plants of Gondwana Period.

Unit IV (Structural Geology, Economic Geology, Indian Stratigraphy)

Rock deformation - types of forces, stress and s t r a i n ; study of outcrops, identification of bedding, data, measurement; dip, strike, rake, plunge; overlap (offlap and onlap); inlier and outlier, klippe and fenster, synclinal hill and anticlinal valley; unconformities - kinds, geological significance and their recognition, diapirs (salt domes); planar and linear structures; folds- definition, style, orientation, morphology geometric and genetic classification; joints- definition, geometric and genetic classification of joints; faults- definition, geometric and genetic classification of faults; foliation- descriptive terminology, kinds, origin and relation to major structures; lineation- descriptive terminology, kinds, origin and relation to major structures; shear zones.

Definition of ore, ore minerals and gangue minerals, grades of ores and non-metallic minerals, assay value and tenor of ore; classification of mineral deposits, Bateman's classification; principles and processes of formation of mineral deposits; magmatic concentration deposits; pegmatitic deposits; sublimation deposits; contact metasomatic deposits; submarine exhalative volcanogenic deposits; hydrothermal deposits (cavity filling and replacement); principles and processes of formation of following mineral deposits- residual concentration deposits; mechanical concentration deposits (placers); sedimentary deposits; evaporites; bacteriogenic deposits; supergene sulphide enrichment deposits; metamorphic and metamorphosed deposits with suitable Indian examples; mineralogy, uses, geological occurrences, origin and geographical distribution of the all types of mineral deposits of India.

Geological time scale; methods of collecting stratigraphic data; principles of stratigraphy; stratigraphic classification- lithostratigraphic, chronostratigraphic and biostratigraphic units; strtigraphic correlation; classification, geographic distribution, lithological characteristics, fossil content and economic importance of the following- Archaean Supergroup of Peninsular India, Dharwar Supergroup and associated granitic rocks, Sausar Group, Sakoli Group, Dongargarh Supergroup, Aravalli Supergroup and associated gneissic rocks. Iron ore Group. Cuddapah Supergroup of Cuddapah basin, Kaladgis, Pakhals, Penganga Formation, Delhi Supergroup, Shimla Formation, Vindhyan Supergroup of Vindhyan basin, Kurnool Supergroup, Chattisgarh

Supergroup; Palaeozoic succession of Spiti valley, Gondwana Supergroup, Triassic of Spiti, Jurassic of Kutch, Rajasthan and Spiti. Cretaceous of Narmada valley, Trichonopoly, Spiti, Lameta Formation, Deccan Traps; Tertiary of Assam and Western India; Siwalik Group; Karewa Formation of Kashmir; Stratigraphy of Maharashtra.

Unit V (Elements of Remote Sensing and Environmental Geology, Elementary Hydrogeology and Geomorphology)

Remote Sensing from aerial heights (Aerial photography); Remote Sensing from space heights (satellite imagery); aerial photography, aerial camera, types of aerial photographs, (black & white, colour and infra-red), flights for obtaining aerial photos, methods of studying aerial photos in the form of mosaics and stereopairs; recognition elements in the study of aerial photos- tone, texture, pattern, shape, size, form, shadow, drainage, vegetation, and landforms. Photographic expressions of various geological features on aerial photos and factors affecting such expressions (climate, vegetal cover, soil, type of weathering *vis-à-vis* nature and composition of rocks); photo-interpretation, guidelines for lithologic, structural and geomorphic interpretation; definition and concept of environmental geology, natural hazards such as earthquakes, floods, volcanic activity, coastal erosion, desertification and their impact on environment; soil types, soil degradation and mitigation, soil pollution; environmental changes due to human dominated environment over nature dominated system; environmental considerations in the constructions of large dams, reservoirs, and tunnels; pollution- its effect on natural ecosystem and anti- pollutional measures (water and air)

Definition of precipitation, percolation, runoff, evaporation and transpiration; hydrologic cycle, occurrence and distribution of groundwater, zones of aeration and saturation, water table, cone of depression and recharge, influent and effluent seepages and springs; hydrologic properties and characteristics of rocks; aquifers and their classification; groundwater provinces of India and Maharashtra; concept of watershed management. Geomorphology-fundamental concepts, weathering, mass-wasting and related landforms, fluvial cycle of erosion, drainage patterns and their significance; karst topography, aeolian and glacial cycles, concept of morphometric regions, topography developed over folded and faulted structures.

PET SYLLABUS

(BASED ON UG SYLLABUS)

BIOCHEMISTRY

UNIT 1: PHYSIOLOGYCAL BIOCHEMISTRY

A. **BLOOD BIOCHEMISTRY**: composition, properties and functions of blood

B. **HORMONE BIOCHEMISTRY AND NEUROBIOLOGY**: overview of different endocrines glands and their hormones, functions, disorders associated with hormones, structure, properties of nerve fibres, transmission of impulse in nerve fibres, synaptic transmission.

C: **REPRODUCTIVE AND RENAL BIOCHEMISTRY**: structure and functions of male and female reproductive hormones, oogenesis, spermatogenesis, urine formation, acid base balance by kidneys.

D: **MUSCLE AND MEMBRANE BIOLOGY**: structure and contraction of muscle fibre composition and structure of plasma membrane, membrane transport.

UNIT 2: BASIC MICROBIOLOGY AND IMMUNOLOGY:

A. **GENERAL MICROBIOLOGY**: history and development of microbiology, classification of microorganisms, structure, nutrition, growth and control of bacteria.

B. **VIRUSES**: structure, classification, general characteristic and replication of viruses.

C. **IMMUNOLOGY**: immune system, immunoglobulins, complement system, Preparation and applications of monoclonal antibodies. Immunological techniques

UNIT 3: BIOMOLECULES AND METABOLISM:

A. **BIOCHEMISTRY OF MACROMOLECULES**: Structure, classification, general properties of carbohydrates, proteins, fats and nucleic acids

B. **BIOENERGETICS**: Free energy concept, high energy phosphate compounds, different techniques involved in metabolic studies.

C. **METABOLISM OF BIOMOLECULES**: Catabolism and anabolism of macromolecules like carbohydrates, proteins, fats and nucleic acids

UNIT 4: BIOPHYSICAL AND ENZYME CHEMISTRY

A. **SPECTROPHOTOMETRIC TECHNIQUES**: Instrumentation, technique and applications of UV- Visible spectrophotometry, spectrofluorometric and flame photometry.

B. **CHROMATOGRAPHY AND ELECTROPHORETIC TECHNIQUES**: (i) Partition principle, column chromatography, gel filtration, ion exchange, affinity, HPLC and gas

chromatography. **(ii)** Factors affecting electrophoretic mobility, paper, gel, disc gel electrophoresis, isoelectric focussing, SDS-PAGE electrophoresis

C. **ISOTOPIC TRACER TECHNIQUE AND CENTRIFUGATION:**
(i) Measurement of radioactivity, measurement of stable isotopes, isotopes used in biochemical studies
(ii) Basic principles of centrifugation, types of centrifuge, preparative and analytical centrifugation.

D. **ENZYME BIOCHEMISTRY:** History, classification, enzyme catalysis, mechanism of action, enzyme kinetics, purity and homogeneity of enzymes

UNIT 5: MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

A. **DNA REPLICATION (PROKARYOTIC):** Basic features of replication, mode of replication, replication enzymes, Types of DNA polymerases and their properties processes, models, DNA damage and repair

B. **TRANSCRIPTION AND TRANSLATION (PROKARYOTIC):** (i) Basic features of transcription, RNA polymerase, transcription processes, regulation of gene expression, reverse transcription, inhibitors of transcription
(ii) Genetic code and decoding system , protein synthesis.

C. **R DNA TECHNOLOGY:** Basic introduction to recombinant DNA technology, restriction endonucleases, vectors, polymerase chain reaction, applications of recombinant DNA technology

RTMNU , NAGPUR

SYLLABUS FOR PET (STATISTICS)

UNIT I: Probability Theory

Probability: Probability definition and axioms. Additive law of probability for two events and its extension for n events, Problems on counting technique, permutations & combinations.

Conditional Probability, Multiplicative law of probability for two events and its extension for n events, independence of events, Bayes' theorem and its applications.

Random variables: Discrete and continuous random variables, Probability mass function and Probability density function, Distribution function of a random variable and its properties, illustrations of random variables, expectation of a random variable, Probability generating function (if it exists), moment generating function, their properties and uses.

 Chebyshev's inequality and applications with problems.

Unit-II: Probability Distributions

Discrete and continuous distributions: Binomial, Poisson, Geometric, Negative Binomial Hypergeometric, Uniform, Normal, Exponential, Gamma, Beta distributions.

Bivariate probability distributions (discrete and continuous): Joint distribution, marginal and conditional distributions, moment generating function, stochastic independence, covariance, correlation coefficient and theoretical problems on these topics. Multinomial Distribution

Bivariate Normal distribution: marginal and conditional distributions, moment generating function

All properties related to the above distributions.

Simple and multiple correlation and regression.

Unit-III: Sampling distributions and Statistical Inference

 Sampling Distributions: Study of Chi-square, t and F distributions along with their properties and applications.

Point Estimation: Point estimator of a parameter, Unbiased estimator, concept of bias and standard errors of the estimators. Concept of UMVUE, Cramer – Rao Inequality and problems on CRLB.

Interval Estimation: Concept of confidence intervals for small and large samples. Construction of Confidence intervals for the mean of univariate normal distribution, Construction of confidence intervals for the difference of two means, confidence interval for variance and ratio of two variances.

Use of central limit theorem in interval estimation. Construction of confidence intervals of a single mean, single proportion and difference of two means and two proportions for large samples.

Concepts of testing of hypothesis: Statistical tests, Null and alternative hypothesis, Types of errors, Critical region, level of significance, p-values, power of a test, Two-tailed and one tailed tests. Problems related to the above concepts. Large sample tests.

Unit-IV: Sampling Techniques and Design of experiments

Sampling Designs: Simple random sampling with and without replacement, sampling for proportions, Stratified Random sampling, Cluster Sampling with equal sizes, Systematic sampling.

Method, Properties and Comparison of the above sampling methods

Design of Experiments: Assumptions involved in A.V. Techniques, one way classification, two way classification with one and multiple but equal number of entries per cell, three way classification

Design of Experiments: General principles of designs of experiments, analysis of completely randomized design. Randomized block and Latin square design, standard error of treatment differences, Estimation of efficiencies.

Factorial experiments: Purpose advantages, 2^2 and 2^3 factorial experiments. Calculations of main effects and interaction effects, Yates' method.

Unit V: Applied Statistics

Time Series analysis: Time series analysis, its different components, additive and multiplicative models, methods of determination of its components, Estimation of elasticity from time series data.

Operations Research: Linear programming problem and different methods of solving LPP.

Transportation problem, Assignment problem, Game Theory, Network analysis.

Statistical Quality Control: Principles, Control charts for mean, standard deviation and range.

Acceptance sampling by attributes, single, double sampling plans continuous sampling inspection plans.

Syllabus for PET – II
Examination
Name of Subject: Computer Science
Faculty of Science and Technology,
Subject Code: 8.13

Unit - I : Discrete Mathematical Structures

Mathematical Logic: Propositional Calculus, Normal Forms, The theory of inference for the Statement calculus, The Predicate calculus. **Fundamentals:** Sets and Subsets, Operations on Sets, Sequences, Division in the Integers, Matrices, Mathematical Structures.**Counting** - Permutations, Combinations, The pigeonhole Principle, Recurrence Relations. **Relations and Digraphs:** - Product sets and Partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations, Computer Representation of Relations and Digraphs, Manipulation of Relations, Transitive Closure and Warshall's Algorithm. **Functions** - Definition and Introduction, Functions for Computer Science, Permutation Functions, Growth of Functions. **Graph Theory:**Basic Concept of Graph Theory, Euler Paths and Circuits, Hamiltonian Paths and Circuits. **Other relations and Structure** - Partially Ordered Sets, Lattices, Finite Boolean Algebras, Functions of Boolean Algebras, Boolean Functions as Boolean Polynomials. **Trees** - Introduction, Undirected Trees, Minimal Spanning Trees.

Unit - II : Programming and Data Structures

Programming in c :
C Character set, Tokens, Identifier, Keywords, Variables, Data types, Qualifiers. Operators and Expressions typedef, Type Conversion, Constants, Declaring Symbolic Constants, Character Strings, Enumerated Data Types, Operator Precedence and Associativity. Library functions. : Maths, string handling Functions. Control Structures,Looping, break statement, continuestatement,goto statement**Arrays:** Single and Two Dimensional Array. Strings: Strings Manipulation, Arrays of Strings, Evaluation order Function: Function Components, Return Data type, Parameter Passing, Return by Reference, Default Arguments, Recursive Functions, Arrays with Functions, Storage Classes.
Data Structures:
Linked List: Linked List, Representation of Single, Double, Header, Circular Single and Double Linked list, All possible operations on Single and Double linked List using Dynamic representation, Polynomial Representation and its Manipulation.
Stacks : Stacks terminology, Representation of Stacks in Memory, Operation on Stacks, Polish Notations, Translation of infix to postfix and prefix expression, Infix to Postfix Conversion, Evaluation of Postfix Expression, Recursion, Problems on Recursion, Quick Sort and Tower of Hanoi Problem. **Queue :** Representation of Queues in Memory, Circular Queue. Dequeue and Priority Queue. Operations of above Structure using Array and Linked Representation. SORTING AND SEARCHING: Selection Sort, Insertion Sort, Merge Sort, Efficiency of Sorting

Methods, Big-O Notations. **Trees :** Basic Terminologies, Representation of Binary Trees in Memory, Traversing of Binary tree, Binary Search Tree, Operation on Binary Search Tree, Heap Tree, Operation on Heap Tree, Heap Sort Method. **Graphs :**Definition and Representation of Graphs in Memory: Linked List and Matrix Representation. Traversing graphs : BSF, DFS Method.

Unit - III : Theory of Computation and Compiler Construction

Finite Automation and Regular Expression : Finite State systems, Basic Definitions, Non - deterministic finite Automata, Finite Automata with moves, Regular Expressions, Two way finite automata, Finite automata with output, Application on Finite Automata. Properties of **Regular Sets :** The pumping lemma for Regular Sets, Close properties of Regular sets, Decision Algorithms for Regular Sets. **Context Free Grammars:** Context Free Grammar, Derivation Tree,Simplification of context Free Grammars, Chomsky Normal Form, Greibach Normal Form, The existence of inherently ambiguous context free languages. Properties of Context free languages : The pumping lemma for CFL's , Closure properties of CFL's, **Push Down Automata :** Informal description, Definitions, Push – Down Automata & Context free languages,**Turing Machines**.

Introduction to Compilers : Compilers and translators, need, the structure of a compiler, Lexical Analysis, Syntax analysis, Intermediate Code generation, Optimization, Code generation, Book keeping, Error Handling, compiler writing tools, The role of the lexical analyzer, Approach to the design of lexical analyzer, Implementation of lexical analyzer. **Basic Parsing Techniques:**Parsers, Shift-reduce parsing, Operator precedence parsing, Top-down parsing, predictive parsers, **Automatic construction of efficient parsers:**LR parsers, The canonical collection of LR(0) items, constructing SLR parsing tables, constructing LALR parsing tables, Symbol Tables, **Code Optimization:** The principal source optimization, Loop optimization, The DAG representation of basic blocks.**Code Generation :**A machine model, a simple code generator, Register Allocation and assignment. Code Generation from DAG's, PeepholeOptimization.

Unit – IV: Database Management System

DBMS : Definition: Databases, DBMS, Problems with traditional file processing system, Objectives of the database systems, Three level architectures of DBMS, Component of DBMS, Database Administrator, Database Users, Data model, Different types of data models, Concepts of Hierarchical, Network Models. **E-R Models :** Basic Concepts, Entity, Attributes, Relation Ship, Mapping, Keys, Weak and Strong Entity Set, Problems on E-R Diagrams, Extended E-R Features: Specialization, Generalization, Aggregation, Problems on Reduction of an E-R Schema to Tables, Tabular representation of Strong, Weak entity Sets and Relationship Sets. **Relational Model:** Structure, Relational Algebra, Fundamental Operations, Set – Intersection, Natural Join, Division and Assignment Operation. Extended Relational Algebra Operations, Aggregate Functions. **Functional Dependency:** Functional Dependency, Fully Functional Dependency, Partial Dependency, Transitive Dependency, Multi Valued Dependency. Normalization, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF, 5NF). Problems on Normal forms.

Unit - V : Data Communication and Network

Introduction: Uses of Computer Networks Section, Network Hardware, Network Software, Reference Models, Example Networks, Network Standardization, Metric Units**The Physical Layer:** The Theoretical Basis for Data Communication Guided Transmission Media,Wireless Transmission, Communication Satellites, The Public Switched Telephone Network Section , The Mobile Telephone System, Cable Television **The Data Link Layer:** Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, Example Data Link Protocols,**The Network Layer:** Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, Internetworking, The Network Layer in the Internet **TheTransport Layer:** The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol, The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance Issues.**The Application Layer:** DNS - Domain Name System, Electronic Mail, World Wide Web, Multimedia.**Network Security:**Cryptography, Symmetric-Key Algorithms, Public-Key Algorithms, Digital Signatures, Management of Public Keys, Communication Security, Authentication Protocols, E-Mail Security,Web Security.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

SYLLABUS

Ph.D. ENTRANCE TEST (PET)

MICROBIOLOGY

SUBMITTED ON DATED 09/04/2021

A) History of Microbiology:
1. Discovery of microbe
2. Theory of biogenesis and a biogenesis.
3. Contributions of Louis Pasteur, Robert Koch, Lister Winogradsky and Beijerink, John Tyndal
4. Branches of Microbiology: a] systemic microbiology including bacteriology, mycology, phycology, virology, b] biotechnology, c] geomicrobiology, d] exobiology,e]medical microbiology, f]environmental microbiology

B) Prokaryotic Cell structure:
1. A Typical Bacterial cell structure,
2. Structure of cell wall of Gram positive and negative bacteria
3. Cell membrane: Fluid mosaic model, mesosomes
4. Ribosomes, Nucleoid, plasmids, Storage granule
5. Capsules, slime layer, Pili,
6. Flagella (including types and structure).
7. Endospore structure, formation and germination
8. Differences between prokaryotes and eukaryotes
9. Exospores, Myxospores, Eukaryotic spores,
10. Significance of dormancy

C) Classification
1. Significance of classification,
2. Intuitive classification,
3. Whittaker five kingdom system,
4. Bergys manual ninth edition, numerical classification,
5. Approaches in modern classification: GC:AT Ratio, DNA Hybridization, 16SrRNA Cataloguining and phylogeny

D) Microbial control
1. Concept of microbial death
2. General terms: Sterilization, inhibition, Microbiostatic, microbicidal, disinfectant, sanitizer, viricide, sporicide, antimetabolite, antibiotic, germicide, Preservative
3. Characteristics of ideal antimicrobial agents.
4. Physical methods; a)Heat and moist sterilization b)Dry sterilization, c)Low temperature, d)Filtration, e) radiation, f) osmotic pressure.

5. Chemical agents: Phenolics, Alcohols, Halogens, Heavy metals, Quaternary ammonium compounds, Bignamides-Chlorohexidines, Surface active agents, Aldehydes
6. Gaseous sterilization
7. Chemotherapeutic agents : i)Mechanism of cell injury ii)Factors influencing antibiotic activity
8. Phenol coefficient

E) Nutritional and growth techniques
1. Isolation of pure culture: various techniques.
2. Determination of C N P etc. by auxeno graphic and replica plate technique
3. Synchronous culture techniques
4. Measurement of growth.

UNIT – II

A) Microbial Nutrition:
1. Nutritional types of bacteria
2. Basic nutritional requirements.
3. Types of culture media, growth, selective, enriched, enrichment, synthetic non synthetic.
4. Axenic cultures, Diauxic cultures.

B) Microbial growth and cell cycle
1. Bacterial cell cycle
2. Principle of growth curve and mathematical expression.
3. Continuous culture: Turbidostat and chemostat.
4. Factors influencing microbial growth.

C) Prokaryotic and Eukaryotic microbes :
1. General characters of a) Proteobacteria, b) Mycoplasma, c) Rickettsia and chlamydia
2. Cyanobacteria: Study of anabena and applications of cyanobacteria
3. Actinomycetes: Streptomysis and their applications
4. Archaebacteria: Methanogenic bacteria and their importance
5. Fungi and yeast: General characters, Asexual and sexual mode of reproduction, slide culture techniques.
6. Algae:-General characters and industrially important algal cells
7. Protozoans: General characters and life cycle of trypanosome

D) Acellular microbes: Viruses.

1. Discovery of viruses, General structure, symmetry and classification
2. Cultivation, chick embryo, tissue culture
3. Detection of viral growth
4. T4-Bacteriophages, lytic cycle, Lysogeny and Lambdaviruses.

E) Microbial interaction.

1. Positive and negative interaction: Commensalism, synergism, syntropism, mutualism, parasitism, predation, antagonism, competition
2. Protist-Protist Interaction: Bdellovibrio
3. Protist-Plant interaction: Root nodule bacteria
4. Protist-Animal interaction: Rumen bacteria, insect midgut bacteria, luminescent bacteria

UNIT – III

A) Microscopy-I

1. Principle and applications of Bright field microscopy,
2. Principle and applications of Dark field microscopy
3. Principle and applications of Electron Microscopy(TEM, SEM)
4. Principle and applications of Confocal microscopy
5. Principle and applications of Atomic Force Microscopy
6. Principle and applications of Phase contrast microscopy
7. Principle and applications of Fluorescent microscopy

B) Staining techniques

1. Stains and dyes, chromophore, auxochrome, chromogens, types of stains.
2. Theory of staining
3. Staining techniques: simple, differential, gram staining, acid fast staining
4. Staining of specific structure: flagella, spores, capsule (negative)

C) Bioinstrumentation

1. Spectroscopy: Laws of absorption, limitations of beer law, UV-Visible spectroscopy and its applications
2. Centrifugation : Type of centrifuge, analytical and ultra centrifugation, density gradient centrifugation
3. Electrophoresis: Principle, types of electrophoresis, agarose gel electrophoresis and SDS-PAGE
4. Chromatography : Thin layer chromatography, ion exchange, gel filtration, HPLC

5. Isotope tracer technique: Method and applications
6. Detection and measurement of stable isotope: Mass spectrometry
7. Detection and measurement of radioactive isotope: GM counter, scintillation counter

D) Industrial Microbiology
1. Primary screening and secondary screening,
2. Strain development
3. Types of fermentation processes
4. Design of typical fermentor and parts of fermentor
5. Types of fermentor
6. Inoculum development
7. Scale up of fermentor process
8. Raw materials for media preparation
9. Harvesting and product recovery
10. Production, biochemistry, recovery of ethanol, penicillin, semisynthetic penicillin, and Vit B12

E) Applied Microbiology
1. Significance of bacteriological analysis of water
2. Collection and handling of water samples
3. Indicators of excretal pollution
4. Bacteriological analysis of water for coliforms and faecal streptococci (MTFT, MFT)
5. Water treatment using SSF and RSF
6. Sewage types, composition, physical, chemical and biological characteristics
7. BOD, COD, ThOD
8. Trickling filter, activated sludge, RBC, sludge digester
9. Microbial analysis of air, settling plate and Anderson technique
10. Biopesticides and biofertilizers
11. Microbial leaching of copper and uranium
12. Spoilage of food and preservation of food
13. Food borne diseases and food intoxication

UNIT –IV

A) Carbohydrates and its metabolism
11. Classification of carbohydrates
12. Structure of glucose, fructose, maltose, lactose, sucrose, raffinose, starch, hyaluronic acid, glycogen, cellulose, osazone formation

13. General strategy of metabolism,
14. EMP pathway and its regulation,
15. TCA cycle and its regulation,
16. Outline of ED pathway,
17. Pentose Phosphate pathway,
18. PK pathway

B) Lipids and its metabolism
1. Classification of lipids
2. Structure of triglyceride, compound lipids, derived lipids
3. Betaoxidation
4. Omegaoxidation

C) Amino acids & proteins and its metabolism
1. Classification of amino acids
2. Titration curve, acidic
3. Basic and neutral amino acids
4. Peptide bond theory
5. Organizational levels of proteins
6. Concept of oligomeric protein
7. Amino acid breakdown, deamination, (alanine, tyrosine, metionone) urea cycle
8. Metabolic breakdown of individual amino acids
9. Glucogenic and ketogenic amino acids
10. Genetic code
11. Prokaryotic translation

D) Enzymology
1. Definitions and nature of enzymes
2. Classification and nomenclature,
3. Primary concept of enzyme kinetics,
4. MM equation and modifications of MM equations
5. Activation energy, transition state, ES complex, enzyme activity, katal, specific activity, turn over number
6. Enzyme inhibition and their types
7. Enzyme regulation, their types,
8. Allosteric sites and allosteric modulaters,

9. Functional diversity such as holoenzyme, apoenzyme, coenzyme, cofactor, prosthetic group, isoenzymes, membrane bound enzymes, multienzyme complex, zymogens

E) Nucleic acid and its replication

1. Structure of purines, pyrimidines, nucleosides, nucleotides, DNA, RNA, and various forms of DNA
2. Replication of DNA, modes of replication, general features, enzymes involved
3. Rolling circle and knife and fork model
4. Prokaryotic transcription including general features, enzymes involved and reverse transcription

Vitamins

1. Types of vitamins
2. Classification on the basis of solubility
3. Functions of vitamins
4. Hyper and hypovitaminosis

Energy Generation

1. High energy molecules
2. Substrate level phosphorylation
3. Cyclic and noncyclic photophosphorylation, Oxidative phosphorylation and ATP generation

UNIT – V

A) Epidemiology and host –parasite relationship

1. Definitions: Signs, symptoms and syndrome of disease, stages of infectious diseases- incubation period, prodromal phase, Invasive phase, decline phase and the period of convalescene, primary infection, secondary infection, acute infection, chronic infection local and systemic infection, Bacteremia, septicaemia, pyamia, toxemia, Viremia, Epidemic, Endemic, Pandemic, Zoonotic, Exotic
2. Dynamics of disease transmission: i) Causative or etiological agents [list] ii) Sources of reservoir of infection, Exogenous Human (case and carrier) Non-living reservoir, Endogenous infections
3. Portal of exit and Portal of entry
4. Mode of transmission- Contact, Vehicle, Vector, Air-borne, transplacental and laboratory/hospital infections
5. Control of communicable diseases: Control of sources, blocking the channels of transmission, protecting the susceptible host

6. Microbial mechanism of Pathogenicity: pathogenicity and virulence, exaltation and attenuation, MID, MLD, ID 50, LD50.
7. Invasiveness: adherence, capsule, enzymes
8. Toxigenicity: Exotoxins and Endotoxins
9. Infectious microbiology: Microbial diseases of skin, eye, digestive, respiratory, cardiovascular, lymphatic, urinary, reproductive and nervous systems

B) Study of pathogenic organisms:
Morphology, cultural characteristics, biochemical characteristics, serology, lab diagnosis
1. Bacteria: *Salmonella typhi* and *paratyphi* A & B.
2. *Mycobacterium tuberculosis*,
3. Spirochetes- *Treponemma pallidum*
4. Viruses: HIV, Hepatitis A & B
5. Protozoa: Plasmodium

Disease control:
1. Basic principle of drug designing.
2. Development of modern drug delivery system.
3. Bacterial cell wall synthesis inhibitor: Penicillin
4. Bacterial protein synthesis inhibitor: chloramphenicol
5. Bacterial DNA synthesis inhibitor: Nalidixic acid, Floxacin antibiotics.
6. Antimetabolites: Trimethoprime, sulfamethoxazole.
7. Non automated and automated in vitro drug susceptibility testing-kirby-Bauer disc diffusion method and e-strip method.
8. Reasons for development of resistance

C) Immunology
1. Innate immunity
2. Acquired immunity
3. Primary lymphoid organs
4. Secondary lymphoid organs
5. Cells of immune system
6. B cell biology (humoral immunity)
7. T cell biology (Cell mediated immunity)
8. MHC
9. Antigen
10. Immunoglobulins
11. Antigen-antibody reactions- agglutination, precipitation, ELISA, Radio immune assay, immune fluorescence technique
12. Hypersensitivity

D) Gene mutation and regulation.

1. Concept of gene, muton, recon, cistron, monocistronic and polycistronic gene, gene within gene, spit gene
2. Gene regulation : lac operon (detail)
3. Mutation : Definition, random vs directed mutation, type of mutation, base pair substitution, frame shift, point, nonsense, missense and silent mutation
4. Genetic suppression: Intergenic and Intragenic
5. Molecular basis of mutation: Mechanism of spontaneous and induced mutation
6. Definition, Basic concept of genetic recombination
7. General types of recombination: Transformation, Conjugation, Transductions
8. Transposable genetic elements (Prokaryotic)

E) Biotechnology

Tools & techniques of genetic engineering:
1. Preparation of pure samples of DNA, range of enzymes used in DNA manipulation, analysis of DNA fragment size, Joining of DNA molecule, vectors and their types.
2. Introducing rDNA into host cell, transformation of cells, identification of transformed cells, and selection of clones, direct and indirect method.
3. Expression of cloned genes, construction of gene library, cells for cloning, expression of prokaryotic genes.
4. PCR and its application, DNA fingerprinting

Application of genetic engineering
1. Health Biotechnology: Production of hormones: insulin, Production of interferon, Production of vaccines: Conventional vaccines: BCG, salk, Diphtheria toxoid, ATS, DNA vaccines, Edible vaccines.
2. Hybridoma technology, monoclonal antibody formation
3. Agricultural biotechnology: Protoplast fusion, Biopesticides. Biofertilizers
4. Industrial biotechnology: Bio sensor and Nano biotechnology applications

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

2021

Faculty of Science

Ph.D. Entrance Test (PET) Syllabus

Environmental Science

Syllabus for PET Examination

Name of Subject: Environmental Science,

UNIT - I: Fundamentals of Ecology and Environmental Science:

Introduction of Environmental Science and Components: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics, Environmental factors, Environmental cycles, Atmosphere (Structure and composition), hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere, Lapse Rate and Temperature Inversion, Climatology, Meteorology.

Basics of Ecology: Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in fresh water habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum. Biotic Factor: Interspecific relationship Positive: Mutualism (symbiosis), commensalism, proto- cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism, Population Ecology, Community Ecology, Ecological Succession, Ecosystem: Definition, structure and function of ecosystem, types of ecosystem, Productivity and Ecological Adaptation

Biodiversity and its conservation: Introduction to Biodiversity: Level of biological organization, the global perspective, Global Environmental changes, Biogeographical regions of India, Biodiversity concepts and patterns, Microbial diversity, Plant diversity, Agro-biodiversity, Soil biodiversity. Types: Species diversity, Genetic diversity, Pattern diversity, Alpha, Beta and Gama diversity, Gradients of Biodiversity, Ecosystem diversity, Measuring of species diversity, richness and evenness, factors related to tropical species diversity.

Factors governing biodiversity, Biodiversity hot-spots, diversity distribution, factors affecting diversity, Mega diversity regions of India, Diversity trends of different ecosystem, Major forest types and distribution of wild life in India, Impact of exotic species, disturbance on diversity, dispersal, diversity-stability relationship, keystone species.

Conservation of Bio-diversity:. Threats to biodiversity, Human interference and habitat destruction, Human & Wildlife Conflicts, biological invasion. Importance of biodiversity conservation, direct and indirect benefits, Bioprospecting, Biopiracy, REDD. Strategies for

biodiversity conservation. In-situ and ex-situ conservation, wildlife habitats and their conservation. Protected Area network, Biosphere Reserves, National Parks, sanctuaries, sacred groves; ex-situ conservation, gene pools, germplasm banks, Biodiversity Action Plan: International conventions on biodiversity, IUCN Criteria, Endemic, extinct, endangered, vulnerable and rare species, Red Data Book. National Policy and Action Plan, Role of Forest Department in Conservation, Biodiversity Legislation in India. Integrated Protected Area System, RAMSAR sites. Existing conservation projects: Tiger, Rhino, Elephant, Turtles, Crocodiles, coral reefs and Mangroves.

UNIT - II: Environmental Pollution:

Air Pollution: Definition, Sources (Natural and Anthropogenic), Chemistry of Air Pollutants, Classification-Primary Air Pollutants, Secondary Air Pollutants & their Adverse Effects of Air Pollutants, Air quality standards and Index, Environmental Segments and Structure of the Atmosphere. Global Problems Associated with Air Pollution: Ozone Layer Depletion, Green House Effect, Global Warming and Climatic Changes, EL-Nino and LA-Nino, Acid Rain, Photochemical Smog, Indoor Air Pollution and Vehicular air pollution, Air Pollution Episode Air Pollution Control Technology: Methods of Control of Air pollution, Air Pollution Control Equipment (Gravity Settling Chamber, Electrostatic Precipitator, Cyclone Collector, and Wet Scrubbers), Sampling of gases and particulate pollutants, analytical methods for monitoring pollutants.

Water Pollution: Sources and Effects of Water Pollution, Types of Water Pollutions, Eutrophication its Effects & Control Measures, Self-Purification, Oxygen Sag Curve, Zones of Pollution, Water Pollutants: Classification of Water Pollutants and their Detrimental Effects, Pesticide's pollutants, Chemical Speciation Scheme, Speciation of Mercury (Hg), Lead (Pb), Cadmium (Cd) & Chromium (Cr), Water Sampling, Objectives, Selection of Sampling Site, Types of Water Samples, Sampling Equipment, Classification of Water Quality Parameters (Organic, Inorganic, Nutrient & Heavy metals), Basic Concept, Significance and Measurement of DO, BOD, COD, Phenol, Polynuclear Aromatic hydrocarbon (PAH) in Water and Wastewater, Bacteriological and Biological examination of water, Approaches to Prevent & Control of Water Pollution, Legislative Measures.

Noise Pollution: Sources of Noise Pollution, Properties of Sound, Sound Pressure and Intensity Levels, Measurement of Noise, Measurement and Analysis of Sound, Equipment Used for Noise Measurements, Effects of Noise Pollution, Approaches for Noise Control, Noise Pollution Control in India, Standards Prescribed for Noise with reference to Indian Context.

Soil and Marine Pollution: Sources of Soil Pollution, Types of soil pollution, Causes, Effects, Soil Microorganisms, Prevention Measures of Soil Pollution (Chemical Methods and Biological Methods), Sources of Marine pollution, Zonation in marine habitat, Impacts of Marine pollution on different zones, Effects of oil pollution & counter measures against oil spills, Marine Pollutants Effects and Control Measures, Specifications for Disposal of Sewage and Industrial Waste in to Sea.

UNIT - III: Water and Waste Water Treatment:

Water treatment: Sources of water supply, Surface and underground sources, Objectives and Principals of the Water Treatment, Potability of Water, Unit Operations and Processes, Theory, Mechanisms, Significance of Aeration, Coagulation, Flocculation and Sedimentation. Filtration, Objectives of Filtration, Classification of Filters, Design Features of Slow Sand & Rapid Sand Filters, Necessity of Disinfection, Chemicals used for Disinfection of treated water,

Plain -Chlorination, Pre- chlorination, Post- chlorination, Super- chlorination, Double chlorination,

Advanced water treatment: Methods of Water Softening (Lime Soda Process, Zeolite Process, Demineralization Process) and their chemical reactions, Role of Ozone and UV as disinfectant. Defluoridation, Chemical Treatment for Defluoridation and Mechanism, Methods of Defluoridation, Reverse Osmosis,.Alkaline Water Ionizer.

Wastewater Treatment: Sources and Objectives of waste water treatment, Preliminary Treatment: Bar, Fine, Self-cleaning and cutting Screens, Grit Chambers, Septic Tank and Imhoff Tanks, Primary Treatment, Sedimentation with Coagulation, Filtration & Disinfection Methods, Secondary Treatment, Activated Sludge Process, Oxidation Pond & Trickling Filter, Tertiary Treatment: Adsorption, Ion Exchange, Activated Carbon.

Basic and Advanced Instrumental Methods: pH, Nephlometry and Turbidometry, Conductivity Meter, Chromatography (TLC), Colorimetry, Spectophotometry, Flamephotometry.

UNIT - IV: Environmental Impact Assessment:

Basic Concept of Environmental Impact Assessment: Definition, Origin and Principles of EIA, Objectives, Need, Types of EIA, Stages in EIA, Environmental Inventory, Baseline - Information on EIA-Environmental Data, EIA Monitoring, Risk Assessment, Positive and Negative Impact, Environmental Impact Statement (EIS): Definition, Steps for EIS Preparation, Methodologies, Role of public in EIA, Sustainable Development: Definition, Basic Concept, Objectives and Consequences and Management of Sustainable Development,

Environmental Impact Analysis: Methods of EIA: Criteria for the Selection of EIA Methodologies, Assessment of Environmental Impact and Methods-Adhoc, Checklist, Matrices, Overlays, Environment Management Plan, Selection of Appropriate Procedures, Case Studies-EIA, Legislation of EIA: Legislation of EIA in India and Modification, Role of Statutory Agencies in EIA Clearance.

Environmental Audit (EA): Introduction to Environmental Audit, Definition, Concept of Environmental Audit and its Importance for Industries, Benefits of EA, Scope and Objectives, Types of Audits, General Audit Methodology, Basic Structure of Audit, Elements of an Audit Process and its Importance, Scope, Advantages of EA, EMS Audit, Significant

Environmental Acts: The Environmental Protection Act 1986, The Wild Life (Protection) Act 1972, The Wild life Protection Rules 1995, The Indian Forest Act 1927, The Forest Conservation Act 1980, Concept of ISO 9000 and ISO 14000 in Environmental System Management (ESM) and Environmental Management Plan (EMP).

UNIT -V: Environmental Management:

Solid Waste Management: Solid Waste and its Sources, Types of Solid Waste, Properties of Solid Waste, Solid Waste Sampling, Objective of sampling, Site selection Criteria, Collection and Handling of Solid Waste Sample, Vermiculture, Composting, Bio-gas from MSW, Indian Scenario and Legislative Control, Municipal Solid Waste (Management and Handling Rules 2000), Processing of Solid Waste, Various Methods of Disposal and Waste Minimisation.

Disaster Management: Natural Catastrophes: Types, Causes, Impact, Control Measures, Policy for Damage Control and Case Studies- Floods, Cyclones, Cloud Bursting, Hurricanes, Earthquake, Land Slides, Volcanism, Tsunami, Droughts and Avalanche, EI-Nino, La-Nino Phenomena, Disaster preparedness, Disaster Mitigation Programmes in India, Rescue and Relief Operation, Risk Mitigating Strategy, National Disaster Management Authority of India its Role and Salient features, Role and Application of Remote Sensing and Geographic

Information System (GIS) in Disaster management .Disaster Management In a Pandemic-PAHO.

Hazardous Waste Management: Definition, Classification, Methods of Treatment and Disposal, Identification and Management of Hazardous Waste, Hazardous Waste Treatment Facility-Planning of Hazardous Waste, Incinerators and Inorganic Waste Treatment Plant, Management and Handling Rules, India-1989,

Environmental Legislation: Water Act, 1988 and Rules, 1975, Air (Prevention and Pollution Act) Act, 1982, Motor Vehicle Act, 1988, Salient Features of Coastal Zone Regulations (CZR) Notification.

Dr. Mrs. Bharati S. Tapase
Assistant Professor
Sevadal Mahila Mahavidylaya, Nagpur

Members

1. **Dr. S.L.Pal**   :

2. **Dr. P.U.Meshram**   :

3. **Dr. B.S.Tapase**   :

4. **Mr. Kaustav Chatterjee :**

Date: 14-04-2021

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
PET II: Syllabus
Subject: Electronics
Faculty: Science and Technology

UNIT I: Semiconductor and Optoelectronics devices

Energy band theory, semiconductor and types, PN junction, forward and reverse biasing, diode equation, diode equivalent circuit, breakdown in diodes, effect of temperature on diode current, ideal diode, basic diode ratings, Semiconductor diode characteristics, Zener diode, Voltage regulator. LED, operation and uses, Photovoltaic devices; Photoconductive cell, Photovoltaic cell, Photodiode, P-N junction and PIN photodiodes, phototransistors, opto-couplers, solar cells, display devices, tunnel diode, PIN diode, Schottky diode, Varactor diode, phototransistors, opto-couplers, solar cells, display devices.

UNIT II: Solid state Switching devices

Construction, working and characteristics of BJT, Biasing and stability, JFET, MOSFET, Construction, working and characteristics of power devices; SCR, DIAC, TRIAC, UJT; triggering circuits, converters, choppers, inverters; AC regulators, speed control of AC and DC motors.

UNIT III: Circuit Analysis and Network Theorems

Kirchoff's Laws, Energy sources AC & DC, Kirchhoff's Current & Voltage Laws, Node and loop analysis method, Superposition, Thevenin, Norton and Maximum power transfer and Millman's theorem.

Transient Behavior of circuit elements under initial and final conditions in RL, RC and RLC circuits for AC and DC excitation, Sinusoidal Voltage and Current; Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values, Series and parallel resonance in RLC, frequency-response of series and Parallel circuits, Q - Factor and Bandwidth, Two port network parameters, transfer functions and signal representation.

UNIT IV: DC Power Supply, Feedback Amplifier and Transducers

Regulated power supply, Rectifiers; HWR, FWR and Bridge, Filter, Voltage regulator ICs; three terminal regulator ICs: 74XX, 79XX. LM 317.

Feedback in amplifiers, Oscillators, function generators, multivibrators; operational amplifiers (OPAMP): characteristics and applications, computational applications,

integrator, differentiator, compators, wave shaping circuits, Active filters, Schmitt trigger, phase locked loop (PLL), Instrumentation amplifier.

Transducers: classification, resistance, inductance, capacitance, piezo-electric, thermo-electric, Hall effect, photoelectric, techogenerators, measurement of displacement, velocity, acceleration, force, torque, strain, speed, sound, temperature, pressure, flow, humidity, thickness, pH, position. Analog and digital modulation techniques.

Biomedical instruments: Types of electrodes, ECG, EEG, EMG, Oximeter and Blood pressure measurements, Shock Hazards.

UNIT V: Modern Digital Electronics

Logic gates, Boolean algebra and K- map, minimization techniques, Logic families; TTL and MOS, Combinational circuits; Half adder and Full adders and Subtractors, encoder and decoder, Multiplexers and Demultiplexers; , memories; A/D and D/A converters.

Flip-flops; RS, CKRS, D, JK, JKMS and T, Counters: Synchronous, Asynchronous, Up and down; shift registers, ring and Johnson's counter, Architecture of 8085, addressing modes, instruction set, interrupts, 8255 PPI, Architecture of 8051, addressing modes, instruction set, interrupts, programming memory and I/O interfacing, serial communication protocols.

UNIT 1: Microbiology, Cell Biology and Immunology

Structure and Function of subcellular & extracellular organelles of Prokaryotic and Eukaryotic (Animal and Plant) cell; Principle, working and applications of various types of microscopes (Bright and dark field, phase contrast, fluorescent microscopy, Electron microscopy). Stains and staining procedures. History and development of Microbiology and Immunology; Classification of bacteria, Archaea and Eubacteria, Brief idea of Bergey's Manual. Bacterial nutrition and growth, Phases of bacterial growth curve. Measurement of growth.Factors affecting bacterial growth. Physical and chemical agents of microbial control. General characteristics of viruses, capsid symmetries, classification and life cycles (Lytic & lysogeny).

Characteristic Immunological defense mechanisms, Cells and organs of immune system, Concept of Antigen and Antibody, Innate and adaptive immunity, humoral and cell mediated immunity, Complement pathway, Structure and classes of Immunoglobulins, Hypersensitivity and Vaccinology.

UNIT 2: Biomolecules, Enzymology and Metabolism

Basic and intricate structural details, organization and functional attributes of Carbohydrates, Proteins, Lipids and Nucleic acids. Methods of Protein and Nucleic acid sequencing, Forces involved in stabilizing protein and nucleic acid structures. Concept of genes and nucleosomal organisation.**Introduction to Enzymology:** Enzyme nomenclature and classification, models of enzyme action, coenzymes, catalytic mechanisms, allosterism, multienzyme systems, enzyme activity measurement, enzyme kinetics, inhibitors and regulatory principles. **Bioenergetics and metabolic principles**. Carbohydrate metabolism: Glycolysis (pathway, regulation and inhibitors); Gluconeogenesis: Bypass reactions, TCA cycle and ETC with oxidative phosphorylation(complete reactions with energetics). Lipid Metabolism: oxidation of fatty acids and fatty acid biosynthesis (enzymology and regulation). Metabolism of Nitrogenous Compounds: Transamination, deamination, Urea cycle: all reactions with regulation, Transmethylation & Decarboxylation, Biosynthesis of purines and pyrimidines: Salvage pathways.

UNIT 3: Biophysical Techniques, Applications and Biostatistics

Principles, instrumentation and applications of UV-Vis Spectrometry, Spectrofluorimetry, Atomic absorption and emission flame photometry. Principles of IR and Mass Spectrometry. Principles, arrangement and applications of different forms and types of Chromatography: Paper, Thin Layer, Gel, Ion Exchange, and Affinity chromatography. Essence of HPLC. Essentials of Paper and Gel electrophoresis, variants and applications: Cellulose acetate, High voltage electrophoresis, SDS-PAGE, Isoelectric focussing, Pulse-field gel electrophoresis.

Basic principles, instrumentation and applications of centrifugation, Preparative and Analytical centrifugation. Isotopic Tracer technique: Various methods of measurements of radio and stable isotopes, their implications and applications in biotechnology. **Immunological Techniques**:Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA. **Biostatistics** Basic concepts: mean, median, mode, Standard deviation and Standard error

UNIT 4: Molecular Biology and rDNA Technology

DNA Replications in prokaryotes: Detailed Enzymology, experimental proof of semiconservative and discontinuous process of replication, factors involved in initiation, elongation and termination. Concept of DNA mutations, mutagens and mutation Repair mechanisms: Mismatch repair, NER, BER, light induced repair, SOS repair. Prokaryotic transcription: Enzymology and auxiliary proteins involved in the process, concept of promoter and other DNA elements, details of initiation, elongation and termination. Regulation of transcription: Lac and trp-operon. Overview of reverse transcription. Prokaryotic Translation: Concept and features of Genetic code, codon-anticodon interaction, tRNA, aminoacyl synthetases, Shine-Dalgarno sequence and initiation of translation, initiation factors, elongation and termination reactions with factors involved, regulation of translation.

Foundations of Genetic engineering, restriction enzymes, vectors, their types (Plasmids, Phage, Cosmids, phagemids, and YAC) and applications, DNA cutting and ligation techniques, transfection, transformation, screening and selection of transformed cells. Concept and methods for creation of cDNA and genomic libraries with their applications. Complete operative principles of PCR and its application in genetic engineering. Applications of recombinant DNA technology in therapy and agriculture. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.

UNIT 5: Applied Biotechnology

Environmental Biotechnology: Drinking water and wastewater treatment process, Concept of COD, DO and BOD. Indicators of faecal pollution and MPN, MF and IMViC techniques for coliforms.Concept of Xenobiotic and recalcitrant compounds, biodegradation, biodeterioration, biotransformation, Bioaccumulation and biomagnification. **Industrial** Biotechnology: Design of typical submerged fermentor, significance of various parts and provisions of fermentor, isolation, primary and secondary screening of industrially important microorganisms.

Food Biotechnology: Production and types of cheese, production of mushroom and spirulina, assessment of microbiological quality of various foods. Industrial awareness: Quality control and quality assurance in food and pharmaceutical industry, concept of current good manufacturing practices in pharmaceutical industry.

Plant Tissue Culture: Composition and preparation of Plant tissue culture media and basic Laboratory facilities, Initiation and maintenance of callus and suspension cultures; micropropagation, regeneration, production of haploids, protoplast culture and somatic hybridization. Concept of transgenic plants and Cloning using Ti plasmid. Bt cotton and other plant applications. **Animal** Tissue Culture: Techniques of animal cell and tissue culture, Culture media, growth factors, laboratory facilities, Characteristics of cells in culture, Cell senescence; cell and tissue response to trophic factors. Primary culture, immortal cells, cell lines. Maintenance of cell lines in the laboratory.

Ph.D - PET Syllabus- Mechanical Engineering
RTMNU. Nagpur (2021)

Unit 1: Basic Sciences: Physics, Chemistry, Maths

A. Semiconductor Physics
Introduction, Types of Semiconductor, Current conduction in semiconductors, pn junction diode, Bipolar transistor

B. Elasticity
Introduction, Stress and strain, Elastic constants, Bending of beam, cantilever.

C. Electron optics
Introduction, Motion of charge particles in electric and magnetic field, Electron refraction, Cathode ray tube, Cathode ray oscilloscope.

D. Lubricants: Classification of Lubricants, Mechanism of lubricants, Properties and application.

E. Corrosion: Chemical reactions responsible of Corrosion of Metals, types of corrosion, control measures and design of materials

F. Fuels: Classification of fuels, determination of calorific value, Octane number, cetane number, knocking, alternative energy sources, Bio diesel.

G. Cement: Types of Cement, manufacture of Portland cement.

H. Definition and Properties of Laplace Transform, Inverse Laplace Transforms and its properties, Convolution Theorem (Statement only).

I. Analytic Function, Cauchy-Riemann Conditions, Harmonic Functions, Cauchy Integral Theorem and Integral Formula (Statement only).

J. Partial Differential Equations of First Order First Degree i.e. Lagrange's Form, Linear Homogeneous PDEs of higher order with constant Coefficients.

K. Discrete and Continuous random variables, Probability Function and Distribution Function.

Unit 2: Thermal Engineering

Fluid Mechanics and machinery: Fluid properties; fluid statics, manometry, buoyancy stability of floating bodies; control-volume analysis of mass, momentum and energy; Bernoulli's equation; dimensional analysis; flow through pipes, head losses in pipes, Turbo machinery: Impulse and reaction principles, Pelton-wheel, Francis and Kaplan turbines, centrifugal and reciprocating pumps.

Thermodynamics: Thermodynamic systems and processes; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of

thermodynamic, thermodynamics cycles. Air compressors; vapour and gas power cycles, I.C. Engines: Air-standard Otto, Diesel and dual cycles. Refrigeration and air-conditioning basic psychrometric processes.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy dimensionless parameters in free and forced convective heat transfer , heat exchanger radiative heat transfer.

UNIT 3: Design Engineering

Engineering Mechanics: Force system, Lami's theorem, principle of moments, Varignon theorem, couple, Friction: static & dynamic friction, laws of friction, angle of friction, coefficient of friction, Simple machines, Principle of virtual work, projectiles, Law of motion, work, power & energy, Belts & Ropes, Newton's universal law of gravitation.

Strength of Materials: Simple stresses & strain, Principle stresses and strains, Centre of gravity and Moment of inertia, Theorem of perpendicular axes, Bending moments and shearing forces, shearing stresses, deflection of beams, Thin cylindrical shells, thick cylinders, Riveted joints, Torsion of shafts, springs, strain energy, Theories of failure.

Theory of Machines: Simple mechanisms, velocity and acceleration in mechanisms, transmission of power by belts and ropes, Gear transmission, Flywheel, Governors, Balancing of masses, Vibrations, Cams.

Machine Design: Variable stresses in machine parts, Riveted joints, Welded joints, Shafts, Belt, chain and rope drives, Bearings, power screws, shafts and keys, springs, couplings, clutches and brakes, Lubrication

UNIT 4: Production Engineering

Pattern Making & Moulding, Gating System & Casting Processes, Joining Processes, Forming Process for metals, and Introduction to Plastics, Introduction to Machining Parameters, Lathe, Shaper, Slotter, Milling, Grinding operations , Drilling, Non- conventional machining Processes, Advanced machining Processes, Jigs and fixtures , Non Traditional Machining process: Electro-Chemical Machining, Theory of metal cutting, Press working ,Forging die design, Design of jigs and fixtures. Classification, Principle, Sensing elements, Standards of Measurement, Limits and Fits, Tolerance analysis of Limits and Fits, Comparators. Work Study: Productivity, Work measurement, Forecasting: Maintenance, Quality Control, Statistical Quality Control. Introduction to NC, CNC & DNC, Introduction to Group Technology, Introduction to flexible manufacturing systems: Manufacturing Planning: Manufacturing system control, Introduction to MIS, Automation, Industrial Robotics ,AS/RS, Automated inspection & Group technology,

Computer aided manufacturing ,Computer aided process planning ,Fundamentals of Robotics, Robots end-effectors, Robot Kinematics, Robot Sensors,

Unit 5: Interdisciplinary

Measurement and metrology
Measurement fundamentals, Measurement Standards, characteristics of instruments, errors, transducers and measuring instruments for physical measurements.

Mechatronics
What is mechatronics, solid state devices, sensors, SCADA, ADC & DAC conversion, Hydraulic and pneumatic actuators, ladder diagram, PLC structure, PLC applications, logic gates and introduction to microprocessor.

Operation Research
Introduction to OR, linear programming, transportation model, game theory, CPM and PERT.

Industrial Economics and entrepreneurship development & industrial Management
Classification of economics, laws of demand, demand analysis and forecasting, factors of production, break even analysis, inflation and inflation control, product development procedure. Principles of managements, material handling, Elements of Material Handling System, Selection of Material Handling, Study of systems and Equipment's used for Material Storage, plant layout, supply chain management, reengineering and business process management.

Rashtrasanth Tukdoji Maharaj Nagpur University, Nagpur
Board of Civil Engineering
Under
Faculty of Science & Technology

Proposed Syllabus for PHD Entrance Test (PET)

Module 1: Structural Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; internal forces in structures; Frictions and its applications.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; simple bending theory, flexural and shear stresses, shear center; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods.

Construction Materials and Management: Construction Materials: Structural Steel – Composition, material properties and behavior; Concrete - Constituents, mix design, short- term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length.

Steel Structures: Limit state design concepts; Design of tension and compression members, beams and beam-columns, column bases; Connections - simple and eccentric, Concept of plastic analysis - beams and frames.

Module 2: Geotechnical Engineering

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One- dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters.

Foundation Engineering: Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils Boussinesq's theory; Pressure bulbs,Shallow foundations– Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under later all loading, pile group efficiency, negative skin friction.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes

Module 3: Water Resources Engineering

FluidMechanics: Propertiesoffluids,fluidstatics;Continuity,momentumandenergyequations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulics ;Channel Hydraulics-Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Module 4: Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment. Sewerage system design, quantity of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Module 5: General Civil Engineering

Linear Algebra: Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.

Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima; Taylor series

Probability and Statistics: Sampling theorems; Conditional probability; Descriptive statistics – Mean, median, mode and standard deviation. Linear regression.

Numerical Methods: Error analysis. Numerical solutions of linear and non-linear algebraic equations; Newton's and Lagrange polynomials. Runge Kutta Method, Gauss elimination method.

Surveying: Principles of surveying; Errors and their adjustment; Maps-scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS.

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments. Geometric design of railway Track – Speed and Cant. Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Syllabus for P.E.T. examination

Name of Subject: Electronics Engineering

Faculty of Science and Technology

Unit-I: Electronics Devices

P-N junction diode, Zener diode, Simple diode circuits: clipping, clamping and rectifiers, BJT and MOSFETs; Single stage BJT amplifiers: biasing, bias stability, small signal analysis and frequency response, JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers and its analysis using small signal JFET model, biasing of FET. MOSFET amplifiers, LED, Photodiode.

Principle of positive and negative feedback, Concept of stability in electronics circuits, Oscillators and multivibrators, Power amplifiers.

Unit-II: Analog Circuits

Operational Amplifiers: Basic differential Amplifier using transistor and its operation, OP-Amp parameters, Characteristic and definition, Ideal OP-Amp, Equivalent circuit, Inverting and Non –Inverting configurations and design.

OP-Amp Linear and non linear applications: Voltage follower, Summing amplifier, scaling and averaging amplifier, Instrumentation amplifier and applications , Integrators and differentiators, Comparators, Schmitt trigger, clipper and clamper, Precision rectifiers, PLL.

Multivibrators: Bistable, Monostable, Astable multivibrator circuits using IC 555, Sample and hold circuits, Voltage reference circuits; Power supplies: ripple removal and regulation.

Unit-III: Networks, Signal and Systems, Control systems

Network Theorems: Superposition, Thevenin and Norton's, Maximum power transfer; Wye-Delta transformation: Time domain analysis of simple linear circuits; solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; 2-port network parameters: driving point and transfer functions; Fourier series and Fourier transform representations, sampling theorem and applications.

Digital signal processing: Discrete time Fourier transform (DTFT), DFT, FFT, Z-Transform, LTI systems, properties, impulse response, convolution, system stability conditions. Digital filter design techniques.

Control system: Basic control system components, Feedback principle, Transfer function; block diagram representation, signal flow graph; Transient and study state analysis of LTI systems, Frequency response, Routh- Hurwitz and Nyquist stability criteria.

Unit-IV: Digital circuits & Microprocessor

Combinational circuits: Boolean algebra, minimization of functions using Boolean identities and K-map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential: latches and flip-flops, counters, shift registers and finite state machines; data converters: sample and hold circuits, ADC and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor(8085): Block diagram, functional description and pin details- addressing modes, complete instructions set and assembler directives- interrupt processing.

Unit- V: Communication

Analog communication: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem.

Digital Communication: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying(ASK,PSK,FSK),QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation. Basics of TDMA, FDMA, CDMA and OFDMA techniques.

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for PET Examination
Name of Subject: Electrical Engineering
Faculty of Science & Technology

Unit 1: Electric Circuits & Measurements

Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Network Theorems, Two-port networks, Three phase circuits, Power and power factor in ac circuits, Linear Time Invariant, Fourier series representation of continuous periodic signals, Applications of Fourier Transform, Laplace Transform

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Different type of transducer, Data Acquisition system, Measurements of Force, Torque, Velocity, acceleration, Measurements of temperature, Pressure and Flow Measurements. Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes

Unit 2: Electrical Machines & Drives

Transformers:

Single phase transformer- equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Autotransformer

Three phase transformers: connections, parallel operation;

Basics of DC and AC Machines, working, characteristics and applications of DC machines, speed control of DC m/cs, three-phase induction machine and three-phase synchronous generator. Speed control methods of three phase induction motor.

Drives: Constant power and constant torque drive, four-quadrant operation, different components of load torque.

Unit - 3: Power Systems

Power generation concepts – conventional & Renewables, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles

of over-current, differential and distance protection; MCB, ELCB, fuses &Circuit breakers, *studies,* Power System stability studies, Load forecasting & generation planning *concept of* load flow, *controls.* Basic Concept & working of FACT devices, Power quality issues.

Unit 4: Control systems

Basic components and their definitions, Mathematical modeling and representation of systems, Feedback principle, transfer function, open and closed loop system, Time response of system, Stability of control system, State variable methods analysis, Frequency response method of analyzing linear system, P, PI & PID controlled

Unit 5: Power Electronics

Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.

(Dr. S. M Kelo)

09.4.2021

Computer Science and Engineering-Computer Engineering

Section 1: Digital Logic and Computer Organization & Architecture

Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Section 2: Programming and Data Structures & Algorithms

Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths

Section 3: Theory of Computation and Compiler Design

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undecidability.

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimisation, Data flow analyses: constant propagation, liveness analysis, common subexpression elimination.

Section 4: Operating System and Databases

System calls, processes, threads, inter-process communication, concurrency and synchronization.
Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.

ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Section 5: Computer Networks

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

PET
CHEMICAL TECHNOLOGY

Unit 1: Ideal Gas laws and their applications. Material balance with or without chemical reaction. Energy balance with or without chemical reaction.

Properties of fluids, Classification of fluids, Shearing and flow characteristics of Newtonian and Non-Newtonian fluids, Shear stress distribution of fluids, Pressure measurement, U- tube, Inverted U-tube, Differential and Inclined manometers, Reynolds number.

Unit 2: Types of chemical reactions such as alkylation, Esterification, hydrogenation.

Polymers: General introduction, types of polymerization. Study of bio-degradable polymers like polylactic acid, polyvinyl esters, polybutyric hydride.

Unit 3: Design of single homogeneous reactors: ideal reactors, design equations for ideal batch reactor, plug flow reactor (PFR) and mixed flow reactor (MFR), size comparison of single ideal flow reactors.

Scope of thermodynamics, Dimensions and Units, Temperature, Pressure, Work, Energy, Heat, Energy conservation & first law of thermodynamics.

Unit 4: Introduction to heat transfer, modes of heat transfer - conduction, convection and radiation, combined mechanisms of heat transfer Basic types of heat exchangers, overall heat transfer coefficient, LMTD method, effectiveness-NTU method

Unit 5: Composition and characterization of waste water. Pollution load and their determination. Unit operations and unit processes involved in the treatment of water and waste water. Preliminary, primary, secondary and tertiary treatment methods of waste water. Municipal and industrial solid waste management.

CHEMICAL ENGINEERING PET SYLLABUS

CH	CHEMICAL ENGINEERING PET SYLLABUS
UNIT NO I	Process Calculations and Thermodynamics
	Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and nonreacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis. First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.
UNIT NO II	Fluid Mechanics and Mechanical Operations
	Fluid statics, surface tension, Newtonian and non-Newtonian fluids, transport properties, shell-balances including differential form of Bernoulli equation and energy balance, equation of continuity, equation of motion, equation of mechanical energy, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, velocity profiles, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.
Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.
UNIT NO III	Heat Transfer and Mass Transfer
	Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.
Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption, membrane separations(microfiltration, ultra-filtration, nano-filtration and reverse osmosis).
UNIT NO IV	Chemical Reaction Engineering and Chemical Technology
	Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, kinetics of enzyme reactions (Michaelis-Menten and Monod models), non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis; rate and performance equations for catalyst deactivation
Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers)

UNIT NO V	Instrumentation and Process Control
	Measurement of process variables; sensors and transducers; P&ID equipment symbols; process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; transducer dynamics; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Syllabus for Pet – II
Examination Name of Subject: Architecture
Faculty: Science and Technology
Subject Code:

Unit – I: The basics of Architecture: a) Theories of architecture basic definitions of architecture, b) Construction techniques and building material, c) Role of structures in architecture.

Unit – II: Environment and Architecture: a) Climate and weather and its impact on architecture, b) Climate responsive architecture, c) Energy saving techniques, d) Rating systems and principles of rating, e) Energy audit of the building, f) Life cycle assessment of architecture.

Unit – III: Society and Architecture: a) Impact of tradition and culture on architecture, b) Semiotics, c) Tribal architecture, vernacular architecture.

Unit – IV: Design in Architecture: a) Design Process, b) Prevailing design approaches, c) Theories of design.

Unit – V: Urban context of Architecture: a) Urban design theories, b) Urban planning issues, c) Urban infrastructure.

Unit – VI: Low cost Techniques: a) Appropriate technologies, b) Re-cycling of building materials, c) Project managements

Unit – VII: Transmission of knowledge in Architecture: a) Aims and objectives of architecture education, b) Methods of teaching/learning architecture, c) Role and eligibility of teachers, d) Architect's Act 1972.

Unit – VIII: Conservation of heritage architecture: a) Conservation, restoration, preservation , principles and techniques, b) Public awareness and participation, c) Values associated with heritage, d) Tourism potential, e) Impact on environment