VITREE – 2016

VIT RESEARCH ENTRANCE EXAMINATION

For
Admission to Research Programmes
at

VELLORE & CHENNAI CAMPUS

INFORMATION BROCHURE
JUNE - 2016
1. ABOUT VIT UNIVERSITY

VIT UNIVERSITY, which was founded in 1984 as Vellore Engineering College, has since grown from strength to strength to its present position as a premier academic institution in this part of the country devoted to education and research in Science, Engineering, Technology, anagement and Humanities. The University owes its origin and its present status to its founder and the great visionary Dr. G. Viswanathan, a former parliamentarian and a former Minister of Tamil Nadu Government.

Declared as a Deemed University by UGC in 2001, VIT University comprises of nine Schools and their constituent Centres.

VIT University offers academic course programmes leading to B.Tech, M.Tech, B.Com., M.Sc., M.S. (Software Engineering), MCA, MBA, degrees and research programmes leading to M.Phil, Integrated Ph.D, M.Tech (by research) and Ph.D degrees in different disciplines. Presently the student-strength of VIT University is about 22000 comprising Indian as well as foreign students. An exceptional feature of this University is its splendid computing centre and the Central library that cater to the needs of all the students and researchers. The Placement Office of the Institute serves as a vital link between graduating students and prospective employers. The University has signed MOU’s with a number of foreign universities in Germany, Australia, Canada and UK. for possible cooperation in some advanced areas like Engineering Management, Mechatronics, Biomedical Engineering, Sensor Technology, Energy and Environmental Engineering.

“Creating Stars“ over 25 years propelled us to move forward in establishing a second campus at Chennai. The campus, spread over 160 acres, is strategically located midway between Vandalur and Kelambakkam in South Chennai amidst IT and Techno parks.

The campus is built to International standards, with ultra-modern learning facilities. The completed campus will house five academic blocks, four 15-storeyed hostels, and facilities for sports and games, and other amenities required for both students and academic communities. The Chennai campus provides high-tech buses for day-scholars.

2. DEGREES OFFERED AND AREAS OF RESEARCH

2.1 Based on the degrees offered from each school or Centre as given in the Table below, the candidates are requested to proceed further for looking at the areas of research available under each of them given in No. 2.2 (Vellore Campus) and 2.3 (Chennai Campus) in the next page

2.2. Areas of research available in the various disciplines at Vellore Campus;

School of Mechanical Engineering:
Computational Fluid Dynamics; Robotics; Tribology (Wear Research); Special alloys and Steels Technology; Environmental Fluid Mechanics; Computational Mechanics; Biomaterials; Surface Engineering; Synthesis and Characterization of Nanomaterials, IC Engines.

School of Civil and Chemical Engineering:
Chemical Engineering: Microwave assisted processing, Membrane development, Process simulation and control, Food processing, Circulating Fluidized Bed, Energy, CFD, Waste minimization and Human waste management.
Civil Engineering: Geotechnical Engineering - Expansive soils - characterization of fundamental behavior, Improving soft clays using stone columns, Granular pile-anchors in expansive soils, Chemical stabilization of expansive clays, Pile Foundations, Laterally loaded Piles, Geotechnical Earthquake Engineering, Rainfall and Earthquake induced landslides, Ground Improvement Techniques, Granular Pile Anchors.

Structural Engineering- Behavior of concrete and concrete structures exposed to elevated temperatures, Optimization of concrete properties, design of experiments (DoE), High Performance Concrete, Concrete Technology, By-product utilization in concrete and Design of concrete structures.

Environmental Engineering - Conventional and emerging air pollutants from transport, industrial and non-vehicle sources on ambient air quality, public health and built infrastructure.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>School/Centre</th>
<th>Vellore Campus</th>
<th>Chennai Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>School of Advanced Sciences</td>
<td>√</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td>School of Bio Sciences and Technology</td>
<td>√</td>
<td>√</td>
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<tr>
<td>3</td>
<td>School of Computing Science &amp; Engineering</td>
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<td>School of Electrical Engig.</td>
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<tr>
<td>5</td>
<td>School of Electronics Engg.</td>
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<td>√</td>
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<tr>
<td>6</td>
<td>School of Information Technology &amp; Engineering</td>
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<td>√</td>
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<tr>
<td>7</td>
<td>School of Mechanical Engineering</td>
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<tr>
<td>8</td>
<td>School of Civil and Chemical Engineering</td>
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<td>9</td>
<td>School of Mechanical and Building Sciences</td>
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<td>10</td>
<td>School of Social Sciences &amp; Languages</td>
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<tr>
<td>11</td>
<td>VIT Business School</td>
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<tr>
<td>12</td>
<td>VIT Law School</td>
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<tr>
<td>13</td>
<td>Centre for Bio separation Technology</td>
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<td>Centre for Disaster Mitigation and Management</td>
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<tr>
<td>15</td>
<td>Centre for Nano biotechnology</td>
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<td>16</td>
<td>Centre for Nanotechnology Research</td>
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<tr>
<td>17</td>
<td>CO2 Research and Green Technologies Centre</td>
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<tr>
<td>18</td>
<td>TIFAC-CORE in Automotive Infotronics</td>
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<td>19</td>
<td>Centre for Biomaterials, Cellular and Molecular Theranostics</td>
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<td>20</td>
<td>Automotive Research Centre</td>
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<td>21</td>
<td>Crystal Research Centre</td>
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</tr>
</tbody>
</table>

√ - Degree Offered;  * - degree not offered  Int. Ph.D. – Integrated Ph.D
Transportation Engineering - Transportation system modelling, Traffic Engineering, Intelligent Transportation Systems, Remote sensing and GIS applications in Civil Engineering, Urban Transportation Planning, Travel Behaviour and Transportation Planning, Travel surveys and analysis, Geo-spatial Technology.

**School of Bio Sciences and Technology:**
Bioinformatics, Biomedical sciences, Biomolecules and genetics, Environmental biotechnology, Industrial biotechnology, Medical biotechnology, Plant biotechnology.

**School of Electrical Engineering:**
Application of electromagnetics, Biomedical signal processing / renewable energy, Control systems optimization, Instrumentation / sensors / wireless sensor networks, Matrix inverter hybrid electrical vehicle DC-DC converter, Nano scale devices, VLSI engineering, Nanotechnology in power systems, Power electronics for renewable energy, Power electronics application in power systems, Power system control renewable energy sources FACTS and power quality, Restructured power system, Smart Grid optimization, Robotics and machine learning, Sliding mode control smart structures, Control theory and design, Smart Grid, FACTS, Reconfiguration of AI techniques, Smart Grid, Micro Grid, Power electronics and application, Soft computing techniques in power systems, Solar and fuel cell, Ultrafast fibre laser and non-linear microscopy.

**School of Electronics Engineering:**
Wireless communications, Optical communications, Microwave communications, Wireless networks, Wireless adhoc and sensor networks, Acoustic and audio signal processing, Adaptive and array signal processing, Radar Signal Processing, Image and Video processing, Biomedical signal processing, RF & MW circuit design (passive & active), Microwave Antenna design, Optical fiber design, Optical Imaging, Fiber Sensors, Embedded systems, MEMS and Sensors, VLSI design for communications and signal processing, Low power VLSI & memory circuit design, Memory Circuit Design, Nanotechnology, Semiconductor device modeling, Quantum dots, Biomedical Engineering.

**School of Computing Science and Engineering:**
1. Theoretical computer science (Natural computing, Algorithms, cellular automata etc.).
2. Computer systems (Computer architecture, networks, databases, embedded systems, network security, network management, distributed computing, grid computing, cloud computing etc.).
3. Human computer Interaction (speech recognition and synthesis, speaker recognition, neural networks, multimodal interface of languages, image processing etc.).
4. Intelligent systems and Knowledge engineering (Artificial intelligence, Data mining, Information).
5. Distributed systems (Cloud, Grid computing, Big data analytics).
6. Information Security

**School of Information Technology and Engineering:**

**VIT-Business School:**
Marketing / strategic marketing / retailing / services marketing / CRM / social media / advertising, CSR / social entrepreneurship, HR & OB / HRM, Financial management / Financial markets and industrial economics / behavior finance and disclosure practices / enterprise management / Islamic banking, IT services, quality and process improvement, lean education quality, Operation management / supply chain management / project management / operations strategy / production and operation management / quality management, Legal / International business. Business analytics.

**Centre for Bioseparation Technology:**
Centre for Nano Biotechnology:
1. Nanotoxicology and Risk Assessment: Toxicological concerns over the usage of nanomaterials have gained momentum off late with significant increase in their commercial production and usage in the consumer products. Our research is motivated towards risk assessment of commercially used engineered nanomaterials through a series of comprehensive toxicity test strategies.
2. Nanobiosynthesis: The main focus is to develop greener technologies for synthesis of nanomaterials and studying their application potential. The approach involves biological resources and bio mimetic methodologies.
3. Biomolecule-Nanoparticle interaction: The gateway to biological applications and biotechnology based solutions. This provides the insight for bio-sensors as well as biomedical applications through bio-inspired modification of nanomaterials.
4. Nanosensors: Here the main thrust is towards developing colorimetric and fluorescence based methods for sensing environmental contaminants (heavy metals, and pesticides), food contaminants (organics, and food borne pathogens), and biomarkers for diseases (medical diagnostics).
5. Environmental Nanobiotechnology: Remediation of several heavy metal contaminated sites is our primary goal. We are working on this aspect using native microbial resources from the polluted sites. Nanomaterial based approach in conjunction with the bioprocess for enhancement of the remediation efficiency is being investigated.
6. Nanoemulsion: Formulation of nanoeumulsions is aimed to enhance the physical properties and application potentials of conventional emulsion based products. This can revolutionize the field of agriculture, pharmaceuticals and cosmetics.
7. Nanoaquaculture: Nanotechnology based solutions for aquaculture industries is the ultimate goal. Harnessing enormous potentials of nanotechnology is a challenge and this is being worked on to bring out practical solutions.
8. Biochemical and Bio systems engineering: We focusing on the production of bio-surfactant for the separation of minerals and to design the processes reactor systems to facilitate bio-removal of Cr(VI) from tannery effluents..

Centre for Nano-Technology Research:

Centre For Biomaterials ,Cellular and Molecular Theranostics
Biomaterials- Development(Metalic/Ceramic/polymer/composites) and nanosurface engineering (Laser/Plasma/EPD/Spin) of biomedical implants/Prosthesis,Evaluation:Mechanical,properties,Tribology,corrosion and Tribocorrosion- biocompatibility:cellular and genotoxicity
Cellular and Molecular therapy: Stem cell biology and application in regenerative medicine, Gene Therapy using viral and nonviral vectors, Neurobiology
Tissue Engineering: Bioinspired tissue engineering, 7D Printing, Microtissues, Biomicrofluidics, cellular communication engineering, Tissue revascularization and reinnervation, nanocomposite scaffold engineering
Cancer Biology: Cancer detection and Imaging techniques
Nanotechnology: Synthesis of nanoparticles, Nanobiosensor, Nanomedicine, Nanoscale Surface Engineering

Centre for Disaster Mitigation and Management:
Disaster mitigation, Earthquake engineering, Flood modeling/Remote sensing/GIS.

TIFAC-CORE in Automotive Infotronics:

CO2 Research and Green Technologies Centre:
New wind mill concept, New bio fuel performance, Solar thermal power plant, Fuel cells and hydrogen production, Cooling cogeneration trigeneration, Investigation on heterogeneous catalysts for transesterification of tri-

School of Advanced Sciences:
Mathematics: Complex Analysis; Fluid Dynamics; Algebra; Graph Theory; Operational Research, Numerical Analysis.
Physics: Thin Films/Sensors/Energy Conservation; Crystal Growth; Gel Dosimetry/ Laser Spectroscopy; Non-linear Fiber Optics/ Photonics; Condensed Matter Physics; Material Science; Medical Physics/Nuclear Physics; X-Ray Crystallography; Ultrasonic; Bio-Materials; Surface Engineering; Synthesis and Characterization of Nanomaterials. Chemistry: Analytical Chemistry; Synthetic Organic Chemistry; Batteries; Nano Materials: Luminescent Materials; Bioanalytical Chemistry; Bioremediation; Electroanalytical; Inorganic solid state chemistry & materials science-Bioceramics; Catalytic materials; Electrochemical & Bio-chemical Sensors; Electron-Transfer reactions; Electroalysis; Thin Films; Chemically modified electrodes; Phyto Chemistry; Environmental Analytical chemistry; Sensor Systems; Mechanisms of inorganic reactions in solutions; In Vitro drug metal ion interactions through kinetic studies; Kinetic and catalytic studies using metal ions and their complexes; Biochemistry; Drug development; Biotechnology; Pharma chemistry; Synthetic Organic Chemistry.
Pharmaceutical Chemistry: Natural Products; Pharmacology; Medicinal Chemistry; Pharmaceuticals; Pharmaceutical Jurisprudence; Pharmaceutical Analysis; Biochemistry; Microbiology; Clinical Pharmacy.
School of Social Sciences and Languages:
English, Hindi, Tamil, Economics, Sociology, Psychology, Commerce.

2.3. Areas of research available in the various disciplines at Chennai Campus:

School of Advanced Sciences:
Physics: Thin Films/Sensors/Energy Conservation; Crystal Growth; Nonlinear Fiber Optics/ Photonics; Material Science; Surface Engineering; Synthesis and Characterization of Nanomaterials, Material processing (both conducting & insulating) by plasma, Hydrocarbon reformation, Nanomaterials for solid state ionic: solid oxide fuel cells, electrochemical sensors, Semiconductor materials and device applications, Computational Nonlinear plasma dynamics; Basic Experimental Plasma physics; Nanomaterials for energy applications; Nanomaterials for industrial application; Catalysis and wastewater treatment; Development of magnetic nanomaterials for sensor applications; Oxide and non-oxide glasses; Micro and nanoelectromechanical Systems (MEMS/NEMS); Laser technology.

School of Social Sciences and Languages:
School of Electronics Engineering:
Wireless communications, Optical communications, Microwave communications, Wireless networks, Wireless adhoc and sensor networks, Image and Video processing, Biomedical signal processing, RF & MW circuit design (passive &

School of Electrical Engineering:
1. Power Electronics and Drives- Power Electronic Converters, DSP and FPGA based Controller Design for Power Converters, Design and Control of Electrical Machines and Drives, Renewable Power Generation Systems
3. Optimization Techniques, Process control, Non-linear Control, Model Predictive Control and Intelligent Controllers

School of Computing Science and Engineering:

School of Mechanical and Building Sciences:
Mechanical:
Civil:
2. Geology and Geotechnical Engineering Geotechnical Engineering: Expansive clay, Soft clay Engineering, Ground Improvement Techniques and applications; Geo-environmental Engineering; Application of artificial neural network in different Geotechnical Engineering problems; Application of Nonomaterials in Geotechnical Engineering.
4. Environmental Engineering; Nanomaterials and Nanocomposites, Water and wastewater treatment, Biofiltration, Sensing of contaminants in water Biological wastewater treatment, Nutrient removal and recovery, reuse and recycle of wastewater, bioremediation, from waste to energy and resource recovery.
5. Water Resources Engineering Surface and Groundwater Modeling, Numerical Modeling, Remote Sensing and GIS based spatial data analysis, modeling and visualization, optimization algorithms in water resources, hydrology modeling, Irrigation and water resources management, soft computing applications in water resources engineering.

**VIT Business School:**

**VIT Law School:**

3. **MINIMUM QUALIFICATION FOR ADMISSION**

   **For Ph.D in Engineering:**
   1. Master’s degree in Engineering/Technology in the relevant discipline with a first class or a minimum of 60% marks/CGPA 6.5 on a 10 point scale in cases where the University/Institute does not award any class or
   2. Equivalent qualifications like M.Sc. (Engineering) / M.S. [By Research.] / M.Tech [by Research].

   **For Integrated Ph.D in Engineering / Technology:**
   Bachelor’s Students with outstanding academic record in the Bachelor’s degree in engineering technology disciplines of Bio-Technology / Electronics, with an aptitude towards advanced scientific and technological research are eligible to apply. A minimum of 80% marks or a CGPA of 8.0 is the primary pre-requisite. Candidates who are appearing for the final examination can also apply provided they meet all the requirements before admission.

   **For M. Tech (by Research) degree:**
   1. A Bachelor’s degree in Engineering/Technology or Master’s degree in Science or Master’s degree in Computer Applications (with Physics & Mathematics at Bachelor’s level) with a first class or a minimum 60% marks/CGPA 6.5 on a 10 point scale in cases where the University/Institute does not award any class. Applicants with M.Sc Computer Science or MCA willing to do Ph.D can register for M.Tech (by Research) and later have an option to upgrade to Ph.D. Please refer to the M.Tech (by Research) regulations in VIT website.
   2. Associate membership of the following professional bodies with a pass in both Parts A & B with 60% marks. (Such candidates are eligible for admission to M. Tech (by Research) Programme in their parent discipline. Their eligibility for other disciplines will be decided on a case-to-case basis).
      - The Institution of Engineers (India)
      - The Aeronautical Society of India
      - The Indian Institute of Metals
      - The Indian Institute of Chemical Engineers
      - The Institution of Electronics and Telecommunication Engineering

   **For Ph.D / M.Phil. in Sciences / Languages:**
   Master’s degree in the relevant discipline of Science with a first class (or a minimum of 60% marks/CGPA 6.5 on a 10 point scale in cases where the University/Institute does not award any class). For Languages, Master’s degree with a minimum of 55% marks.

   **For Ph.D in Management:**
   Master in Business Administration with a first class or a minimum of 60% marks/CGPA 6.5 on a 10 point scale in cases where the University/Institute does not award any class.

   **For M.Phil in Management:**
   Master’s degree in the relevant discipline of Management with a first class (or a minimum of 60% marks/CGPA 6.5 on a 10 point scale in cases where the University/Institute does not award any class).

4. **CATEGORIES AND ELIGIBILITY**

   **Internal Full Time candidates:**
A candidate who wishes to work for Ph.D / M.Tech (by Research) / Integrated Ph.D / M.Phil. degree on full time basis (including project staff working in sponsored projects being carried out at the Institute) should apply in the prescribed form on or before the specified date.

**Internal Part Time candidates:**
All the staff members of the Institute having the requisite minimum qualifications can work on a part time basis for Ph.D / M. Tech (by research) / M.Phil. degree. They should also apply in the prescribed form on or before the specified date.

**External Part Time candidates:**
Teachers working in other colleges in a permanent position and candidates sponsored by R&D organizations of following categories are eligible to apply to work on a part time basis for Ph.D /M. Tech (By Research) / M.Phil. degree:
- Laboratories run by the Council of Scientific and Industrial Research/ Department of Atomic Energy / Department of Space etc.
- Public Sector undertakings with R & D Units.
- Private Industries recognized by The Department of Scientific & Industrial Research, Government of India as engaged in R&D work or contributing to R&D efforts. A copy of the certificate issued by the Department of Scientific and Industrial Research (DSIR) in this regard will be required to be produced in such cases.
- Medical Industry, Institutions and Hospitals with approved R&D in the relevant area. (A copy of the certificate issued by the appropriate authority to be produced).

*For all the Research Programmes, it is mandatory that the candidate should have studied in regular, full time and formal education in their previous degree programmes (UG and PG).*

**International candidates:**
Candidates of foreign nationality who hold Degrees from Indian Universities seeking admission to research programmes with the necessary clearance from the Government of India (The Ministry of Human Resource Development) and possess valid Visa will be treated on par with Indian nationals for purposes of admission to the Institute. Foreign nationals with foreign degrees must meet the minimum educational requirements as given in Section 3. Their degrees must be equivalent to Indian degrees mentioned in Section 3 in Engineering/ Technology/ Science and they should have a good academic record. International Students are expected to have a good working knowledge of English. Candidates with valid GRE and TOEFL scores will be given preference. The case of each foreign applicant will be examined and admission will be offered purely on merit.

**5. MINIMUM PERIOD OF STUDY**

**Doctor of Philosophy (Ph.D):**
The minimum period of study and research from the date of registration for the Ph.D programme to the date of submission of thesis will be 30 months for full-time research scholars and 36 months for part-time research scholars.

**Integrated Ph.D:**
The minimum period of study and research from the date of registration for the Integrated Ph.d programme to the date of submission of thesis will be 4 years.

**M. Tech (by Research):**
The minimum period of study and research required from the date of registration for the M. Tech (by Research) programme to the date of submission of thesis will be 24 months for full-time research scholars and 36 months for part-time research scholars.

**Master of Philosophy (M.Phil):**
The minimum period of study and research from the date of registration for the M.Phil programme to the date of submission of thesis will be 18 months for full-time research scholars and two academic years for part-time research scholars.

6. SELECTION PROCEDURE
The candidates, who satisfy the criteria prescribed, shall appear for VITREE (VIT Research Entrance Examination) which will be a computer based test (CBT). The question paper will have 100 MCQs (Technical – 70 questions; English communication skills – 15 questions; Statistics and probability – 15 questions). VITREE examination centres and centre codes are listed below.

VITREE Centres: Bangalore, Bhopal, Chennai, Chandigarh, Coimbatore, Hyderabad, Indore, Jaipur, Kochi, Kolkata, Lucknow, Madurai, Nagpur, New Delhi, Patna, Pune, Vellore, Vijayawada.

Short listed candidates will be called for interview at Vellore and Chennai Campus on 25.06.2016.

Subjects and Subject codes: Given in the next page

<table>
<thead>
<tr>
<th>Code</th>
<th>Subjects</th>
<th>Code</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBT</td>
<td>Bio Sciences &amp; Bio-Technology</td>
<td>ECO</td>
<td>Economics</td>
</tr>
<tr>
<td>BME</td>
<td>Biomedical Engineering</td>
<td>HIN</td>
<td>Hindi</td>
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<td>BMT</td>
<td>Biomaterials, Cellular and Molecular Theranostics</td>
<td>ITE</td>
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<td>BST</td>
<td>Bio-separation Technology</td>
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<td>MGT</td>
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<td>CO2 Research &amp; Green Technologies</td>
<td>NBT</td>
<td>Nano Biotechnology</td>
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7. FEES

<table>
<thead>
<tr>
<th>Programme</th>
<th>Registration Fee (Rs.)</th>
<th>Tuition Fee (Rs.)</th>
<th>Thesis Fee (Rs.*)</th>
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<tr>
<td>Ph. D. Internal Full Time with Research Assistantship</td>
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8. JOINING THE RESEARCH PROGRAMME

The candidates admitted to Ph.D / Integrated Ph.D / M. Tech (by Research)/ M.Phil degree programme will have to report by 08.07.2016. All original documents/ certificates should be submitted in the Admissions office along with the tuition fee at the time of joining.

9. RESEARCH ASSOCIATESHIP

VIT University encourages research activity by awarding research associateship for all Ph.D and M. Tech (by Research) candidates on the basis of a selection interview. Apart from this, scholars with the following qualifications are encouraged to apply:

- Scholars possessing JRF (CSIR / UGC).
- Valid GATE score certificate.
- Gold medalist from universities who are eligible to apply and get Inspire Fellowships.
- Eligible Scholars form minority community and backward community eligible to get Rajiv Gandhi Scholarships.
- Scholars after two years of experience as a Research Associate in VIT having good publications are encouraged to get SRF form national agencies.

10. OTHER INFORMATION

- The candidates have to make their own arrangements for their stay at Vellore / Chennai during their research programme.
- All suits and actions arising out of or relating to VIT University shall be instituted within the jurisdiction of courts at Vellore, Tamil Nadu.
- Further correspondence / enquiry can be made to the Director (PG Admissions) over phone, (No. + 91-416- 220 2922, 220 4600, 220 4700) or in person between 8.30 am to 5.30 pm on all working days except Saturdays and Sundays.
SYLLABUS FOR ENTRANCE EXAMINATION

BBT—BIO SCIENCES AND BIO-TECHNOLOGY

Unit 1: Biophysics and Biochemistry
Levels of structures in biological macromolecules. basic strategies in biophysics. Forces that determine protein and nucleic acid structure, Prediction of proteins structure, nucleic acids, Properties of lipid bilayers, Biochemical Kinetics studies, unimolecular reactions, methods of determining macromolecular structures inclusive of the spectroscopic techniques like UV-vis absorption, IR absorption, circular dichroism fluorescence NMR and X-ray and neutron diffraction techniques.
Structure and properties Amino acids, peptides, proteins and conjugated proteins, protein hydration, coagulation, denaturation - gelation, protein-protein interactions, cytosolic and membrane properties, purines, pyrimidines, nucleosides, nucleotides, polynucleotides, Ribonucleic acids and deoxyribonucleic acids, TCA cycle, glycolysis, pentose phosphate pathway, Embden Meyerhof pathway, urea cycle, metabolic regulation, respiratory chain, TP cycle, energy rich compounds, integrated metabolism, Carbohydrates - linear and branched carbohydrates, N containing carbohydrates, cell wall carbohydrates, metabolism of carbohydrates, Fats and oils-structure and properties of saturated and unsaturated fatty acids, glycerolipids, phospholipids, sphingolipids, glycolipids, steroids, Vitamins and mineralstypes, structure and functional properties of vitamins, utility of essential minerals sources and trace elements.

Unit 2: Biotechnology
Importance and economics of downstream processing in biotechnology process-problems and requirements of bioproduct purification, process design criteria, primary separation and recovery process, membrane based separations, precipitation methods, different types of purification and chromatographic techniques. Food biotechnology, Types of reactors - ideal reactors, integral method of analysis for reactions, simultaneous, consecutive and combined reactions, models for non-ideal flow. Industrial biotechnology -isolation, preservation and improvement of industrial microbes for overproduction of primary and secondary metabolites, economics of modern industrial processes, plant cell culture, Agrobacterium mediated gene transfer, fermentation processes and biological waste treatment processes.

Unit 3: Molecular Biology and Cell Structure & Function of the Organelles
Eukaryotic and Prokaryotic cells, cell division, mitosis & meiosis cell cycle and molecules that control cell cycle, endocytosis and Exocytosis. Ultrastructure of cellular organelles, viz. Mitochondria, ER, Golgi, Chloroplast, plasma membrane, centriole, nuclear and membrane bound receptors, Signal Transduction, Techniques of propagation of prokaryotic and Eukayotic cells, Autocrine, Paracrine and Endocrine models of action, Cell line, generation of cell lines. Structure of DNA and histone molecules, Replication of eukaryotic chromosomes, nucleoid the complex replication apparatus, process of transcription and, Structure of tRNA, mRNA, rRNA, Deciphering of the genetic code, Translation, Mutation. Reverse transcription.

Unit 4: Genetics and Recombinant DNA

General principles of cloning, Genetic elements that control gene expression, method of creating recombinant DNA molecules creating transgenic animals, plants microbes, safety guidelines of creating recombinant DNA research, restriction enzymes and mapping of DNA, plasmid and phage and other vectors. Construction of genomic and cDNA libraries, methods of nucleic acid extraction. Transformation, Patents and methods of application of patents.
**Unit 5:** Environmental Sciences

**Unit 6:** Immunology
Innate Immunity, Adaptive Immunity, Cell mediated Immunity, Phagocyte, cells B and T cells - structure and function of Antibody molecules, Antigen processing and presentation, Monoclonal antibody, Autoimmunity and hypersensitivity.

**Unit 7:** Microbiology
Basic concepts of Microbiology and classification, Bacteriology, Virology, Mycology, Parasitological, Recombination.

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**BME—BIOMEDICAL ENGINEERING**

**Unit 1: Basics of Circuits**

**Unit 2: Transducers and Measurement**
Resistive, Capacitive, Inductive and piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational), force, torque, vibration and shock.

**Unit 3: Analog Electronics**

**Unit 4: Digital Electronics**

**Unit 5: Signals, Systems and Communications**

**Unit 6: Electrical and Electronic Measurements**

**Unit 7: Analytical, Optical and Biomedical Instrumentation**

**Unit 8: Mathematics**
Linear algebra, calculus, differential equations, numerical methods, probability theory.
BMT—BIOMATERIALS, CELLULAR AND MOLECULAR THERANOSTICS

Biomaterials: Development (Metallic/Ceramic/polymer/composites) and nanosurface engineering (Laser/Plasma/EPD/Spin) of biomedical implants/Prosthesis, Evaluation: Mechanical properties, Tribology, corrosion and Tribocorrosion-biocompatibility: cellular and genotoxicity.

Cellular and Molecular therapy: Stem cell biology and application in regenerative medicine, Gene Therapy using viral and nonviral vectors, Neurobiology.

Tissue Engineering: Bioinspired tissue engineering, 3D Printing, Microtissues, Biomicrofluidics, cellular communication engineering, Tissue revascularization and reinnervation, nanocomposite scaffold engineering.

Cancer Biology: Cancer detection and imaging techniques.

Nanotechnology: Synthesis of nanoparticles, Nanobiosensor, Nanomedicine, Nanoscale Surface Engineering.

BST—BIO-SEPARATION TECHNOLOGY

Unit 1: Biochemistry: Building blocks of Life, Basic biochemistry of carbohydrates, lipids, nucleic acids, enzymes and proteins; Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.), Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties), Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes, Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).

Unit 2: Separation Science: Principles and theory of Chromatography, types of chromatography, mechanism of interaction (ion exchange, hydrophobic, affinity chromatography) and its applications in separation and analysis biomolecules such as proteins, peptides and small molecules of therapeutic importance.

Unit 3: Cell Biology: Membranes, cellular organelles structure and function, cellular communication and signaling, Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth. Cell Biology techniques including microscopy techniques, histochemical and immunotechniques such as ELISA, Western, immunoprecipitation etc.

Unit 4: Immunology: Cells and molecules involved in innate and adaptive immunity, B and T cell epitopes, structure and function of antibody molecules, antibody diversity, antibody engineering, antigen-antibody interactions, primary and secondary immune modulation.

Unit 5: Molecular Biology: DNA, RNA, structure and function, DNA Replication, Transcription and Translation; Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons; Recombinant DNA Technology, Transgenic plants and animals, molecular techniques like protein sequencing methods, detection of post-translation modification of proteins; DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques.


CHL—CHEMICAL ENGINEERING

Unit 1: PROCESS CALCULATIONS AND THERMODYNAMICS

Laws of conservation of mass and energy; use of tie components; recycle, bypass and purge calculations; degree of freedom analysis. First and Second laws of thermodynamics. First law application to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: equation of state and departure function, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibria.

Unit 2: FLUID MECHANICS AND MECHANICAL OPERATIONS

Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, Macroscopic friction factors, energy balance, dimensional analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and
fluidized beds, elementary boundary layer theory, size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids

Unit 3: HEAT TRANSFER
Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

Unit 4: MASS TRANSFER
Fick’s laws, molecular diffusion in fluids, mass transfer coefficients, Theories of mass transfer; 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.

Unit 5: CHEMICAL REACTION ENGINEERING
Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

Unit 6: INSTRUMENTATION AND PROCESS CONTROL
Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response and controller tuning, cascade, feed forward control.

Unit 7: PLANT DESIGN AND ECONOMICS
Process design and sizing of chemical engineering equipment such as compressors, heat exchangers, multistage contactors; principles of process economics and cost estimation including total annualized cost, cost indexes, rate of return, payback period, discounted cash flow, optimization in design.

Unit 8: CHEMICAL TECHNOLOGY
Inorganic chemical industries; sulfuric acid, NaOH, 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

CHY—CHEMISTRY

Unit 1: Physical Chemistry

Unit 2: Inorganic Chemistry
Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules, Concepts of acids and bases, Chemistry of the main group elements and their compounds. Allotropy, synthesis, bonding and structure, Chemistry of transition elements and coordination compounds – bonding theories, spectral and magnetic properties, reaction mechanisms, Inner transition elements – spectral and magnetic properties, analytical applications, Organometallic compounds - synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis, Cages and metal clusters, Analytical chemistry- separation techniques. Spectroscopic electro- and thermoanalytical methods, Bioinorganic chemistry – photosystems, porphyrines, metalloenzymes, oxygen transport, electron- transfer reactions, nitrogen fixation, Physical characterisation of inorganic compounds by IR, Raman, NMR,
EPR, Mössbauer, UV-, NQR, MS, electron spectroscopy and microscopic techniques, Nuclear chemistry – nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

**Unit 3: Organic Chemistry**

IUPAC nomenclature of organic compounds, Principles of stereochemistry, conformational analysis, isomerism and chirality, Reactive intermediates and organic reaction mechanisms, Concepts of aromaticity, Pericyclic reactions, Named reactions, Transformations and rearrangements, Principles and applications of organic photochemistry. Free radical reactions, Reactions involving nucleophilic carbon intermediates, Oxidation and reduction of functional groups, Common reagents (organic, inorganic and organometallic) in organic synthesis, Chemistry of natural products such as steroids, alkaloids, terpenes, peptides, carbohydrates, nucleic acids and lipids, Selective organic transformations – chemoselectivity, regioselectivity, stereoselectivity, enantioselectivity. Protecting groups, Chemistry of aromatic and aliphatic heterocyclic compounds, Physical characterisation of organic compounds by IR, UV-, MS, and NMR.

**Unit 4: Interdisciplinary topics**

Chemistry in nanoscience and technology, Catalysis and green chemistry, Medicinal chemistry, Supramolecular chemistry, Environmental chemistry.

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**CMA—COMMERCE**

**Unit 1: Accounting for financial decisions**


**Unit 2: Business Research Methodology**


**Unit 3: Banking and Insurance**


**Unit 4: Marketing Management**


**Unit 5: Human Resource and Organizational Behaviour**


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**CO—CO₂ RESEARCH AND GREEN TECHNOLOGIES**

**Unit 1: Renewable Energy Technologies**


**Unit 2: Hydrogen and Fuel Cells**

Production of hydrogen – Steam reforming, thermal decomposition etc. - Purification - Desulfurization, removal of CO₂, CO, etc. - Electrolytic hydrogen production – Electrolyzer configurations - Thermolytic hydrogen production – Direct dissociation of water, chemical dissociation of water, photolytic hydrogen production, photobiological hydrogen production.

**Unit 3: Alternative Fuels**

Fossil fuels and their availability - Potential alternative liquid and gaseous fuels - Production and properties of CNG, LPG, biogas and producer - Storage, distribution and safety aspects Sources of Hydrogen - Properties - Production of

**Unit 4: Bio-Energy Technology**


**Unit 5: Wind Energy Technology**

Wind resource Types of wind mills – principles of blade design Actual power from a turbine – electric generators – its types – power generation and transmission - grid interface – power evacuation – capacity utilization factor - drive train oscillation - effect of speed on generation - other electrical characteristics of turbines.

**Unit 6: Environmental Science and Technology**

Isolation and estimation and remediation of environmental contaminants - Inorganic and organic components of industrial effluents - Determination of Heavy metal from waste water – Remediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides - Determination of Pesticides and other organic chemicals like azo compounds - ploy aromatics, etc., in water - Degradation of xenobiotic compounds - Simple aromatics, aliphatics, Chlorinated polyaromatic compounds, petroleum products, pesticides and surfactants. Wastewater management wastewater characteristics, biological wastewater treatment, unit operations, design and modelling of activated sludge process, design and modelling of trickling filter. Treatment of industrial wastes Dairy, pulp, leather, petrochemicals, distilleries, Solid waste management, Bio-fouling, biocorrosion, Bioleaching.

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**CSE—Computer Science and Engineering**

**Unit 1: Engineering Mathematics**

Mathematical Logic: Propositional Logic; First Order Logic.
Probability: Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions; uniform, normal, exponential, Poisson, Binomial.
Set Theory & Algebra: Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra.
Combinatorics: Permutations; Combinations; Counting; Summation; generating functions; recurrence relations; asymptotics.
Graph Theory: Connectivity; spanning trees; Cut vertices & edges; covering; matching; independent sets; Colouring; Planarity; Isomorphism.

**Unit 2: Digital Logic**

Boolean algebra, Design and synthesis of combinational and sequential circuits, Minimization, Number representations and computer arithmetic (fixed and floating point).

**Unit 3: Computer Organization and Architecture**

Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

**Unit 4: Programming and Data Structures**

Programming in C; Functions, Recursion, Parameter passing, Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps, graphs.

**Unit 5: Algorithms**

Searching, sorting, hashing, Asymptotic worst case time and space complexity, Algorithm design techniques: greedy, dynamic programming and divide-and-conquer, Graph search, minimum spanning trees, shortest paths, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

**Unit 6: Theory of Computation**

Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.
Unit 7: **Compiler Design**: Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

Unit 8: **Operating System**: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Unit 9: **Databases**: ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Unit 10: **Computer Networks**: ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.

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**CVL—CIVIL ENGINEERING**

**Unit 1: STRENGTH OF MATERIALS**
Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/energy methods, analysis by displacement methods (slope deflection method), influence lines for determinate and indeterminate structures. Bending moment and shear force in statically determinate beams. Simple stress and strain relationship Stress and strain in two dimensions, principal stresses, stress transformation, Mohr’s circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre.

**Unit 2: REINFORCED CONCRETE STRUCTURES**
Concrete Technology- properties of concrete, basics of mix design. Concrete design-basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of pre-stressed concrete, analysis of beam sections at transfer and service loads.

**Unit 3: STEEL STRUCTURES**
Analysis and design of tension and compression members, beams and beam columns, column bases. Connections simple and eccentric, beam-column connections, plate girders and trusses. Plastic analysis of beams and frames.

**Unit 4: GEOTECHNICAL ENGINEERING**
Soil classification, three - phase system, fundamental definitions, relationship and interrelationships, permeability and seepage, effective stress principle, consolidation, compaction, shear strength. Sub-surface investigations- scope, drilling bore holes, sampling, penetration tests, plate load test. Earth pressure theories, effect of water table, layered soils. Foundation types foundation design requirements. Shallow foundations bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysis in sands and clays. Deep foundations - pile types, dynamic and static formulae, load capacity of piles in sands and clays, negative skin friction.

**Unit 5: WATER RESOURCES ENGINEERING**
Unit 6: ENVIRONMENTAL ENGINEERING

Unit 7: TRANSPORTATION ENGINEERING
Highway Planning - Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements. Traffic Engineering - Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

DMM—Disaster Mitigation & Management

Unit 1: Disasters - Basic concepts - Global problem - Geological hazards
Earth Quake and Landslides - hydrological hazards - Cyclone - Flood - Epidemics - Sea level rise - Forest fire – Indian Disaster Scenario – Disaster Management Cycle.

Unit 2: Natural Disasters - Geologically related disasters

Unit 3: Man-made disasters

Unit 4: Vulnerability and Risk Assessment

Unit 5: Prevention and Mitigation
Personal mitigation - knowing and avoiding unnecessary risks - assessment of possible risks to personal/family health and to personal property. Structural Mitigation - proper layout of buildings, disasters resistant structures. Non- Structural Mitigation measures taken other than improving the structure of building.

Unit 6: Disaster Preparedness
Definition Emergency - difference between an emergency and a disaster role of politics play in emergency management planning - precautions can be taken to prevent during disasters - Role of a Community Emergency Response Team - surveillance techniques - conduct a disaster assessment - role of the emergency operations center in a community developing emergency operations plan - individual or community plan for emergencies - emergency support functions - use of internet used in preparedness - roles do the media plan in disaster Management.

Unit 7: Rescue
Characteristics, operations and logistics for response and recovery – Medical emergencies - Post disaster review - Disaster Legislation - Resources and Utilization – Cost reduction and effective analysis.
Rehabilitation and reconstruction - Training public awareness and research.

**ECE—ELECTRONICS ENGINEERING**

**Unit 1: ENGINEERING MATHEMATICS**
Linear Algebra: Matrix Algebra, Systems of linear equations, Eigen values and eigen vectors.
Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima,
Multiple integrals, Fourier series. Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.
Differential equations: First order equation (linear and nonlinear), Higher order linear differential equations with constant co-efficient, Method of variation of parameters, Cauchy’s and Euler’s equations, Initial and boundary Value problems, Partial Differential Equations and variable separable method.
Complex variables: Analytic functions, Cauchy ’s integral theorem and integral formula, Taylor’s and Laurent’ series, Residue theorem, solution integrals.

**Unit 2: NETWORK THEORY**
Network graphs: Matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solution methods; nodal and mesh analysis. Network theorems; superposition, Thevenin and Nortan’s, maximum power transfer, wye-delta transformation, steady state sinusoidal analysis using phasors, fourier series, linear constant co-efficient differential and difference equations; time domain analysis of simple RLC circuits. Laplace and Z transforms: frequency domain analysis of RLC circuits, convolution, 2-port network parameters, driving point and transfer functions, state equation for networks.

**Unit 3: ELECTRONIC CIRCUITS**
DIGITAL CIRCUITS
Boolean algebra; minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits: arithmetic circuits, code converters, multiplexers and decoders. Sequential circuits: latches and flip-flops, counters and shift- registers. Comparators, timers, multivibrators. Sample and hold circuits, ADCs and DACs. Semiconductor memories. Microprocessor (8085): architecture, programming, memory and I/O interfacing

**Unit 4: CONTROL SYSTEMS**
Basic control system components; block diagrammatic description, reduction of block diagrams, properties of systems: linearity, time-invariance, stability, causality. Open loop and closed loop (feedback) systems. Special properties of linear time-invariance (LTI) systems- transfer function, impulse response, poles, zeros, their significance and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI system and frequency response. Tools and techniques for LTI control system analysis: Root, loci, Routh_Hurwitz criterion, Bode and Nyquist plots;
Control system compensators: elements of lead and lag compensations, elements of proportional-integral- Derivative (PID) control. State variable representation and solution of state equation for LTI systems.

**Unit 5: COMMUNICATION SYSTEMS**
Fourier analysis of signals - amplitude, phase and power spectrum, auto-correlation and cross-correlation and their Fourier trans-forms. Signal transmission through linear time-invariant (LTI) systems, impulse response and frequency response, group delay, phase delay. Analog modulation systems-amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodynerreceivers, elements of hardwares realizations of analog communication systems. Basic sampling theorems. Pulse code modulation (PCM), differential pulse code modulation (DPCM), delta modulation (DM). Digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK). Multiplexing - time division and frequency division. Additive Gaussian noise; characterization using cor-
relation, probability density function (PDF), power spectral density (PSD). Signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions.

Unit 6: ELECTROMAGNETICS

Elements of vector calculus: gradient, divergence and curl; Gauss and strokes theorems, maxwells equation: differential and integral forms. Wave equation. Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth Transmission lines: Characteristic impedance; impedance transformation; smith chart; impedance matching pulse excitation. Wave guides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Antennas; Dipole antennas; antenna arrays; radiation pattern; reciprocity theorem, antenna gain.

ELE—ELECTRICAL ENGINEERING

Unit 1: Electrical Circuits

Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thévenin’s, Norton’s and Superposition and Maximum Power Transfer theorems, two port networks, three phase circuits.

Unit 2: Electrical Machines

Single phase transformer - equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers - connections, parallel operation; autotransformer; energy conversion principles; DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors - principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines - performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

Unit 3: Control Systems and Instrumentation

Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Nyquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability. Classification of Instruments, Moving iron, Moving Coil, Permanent magnet, and Dynamometer types. Thermal, Electrostatic Rectifier Instruments, Instrument transformers, CT, PT, Power measuring instruments, power factor, frequency meters and synchroscope. Measurement of low, medium and high resistances, AC and DC measuring bridges, Magnetic measurement. General Transducers voltage, current, phase angle, optical, Hall effect and Industrial transducers.

Unit 4: Analog and Digital Electronics

Characteristics of diodes, BJT, FET; amplifiers - biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers -characteristics and applications; simple active filters; VCOs and timers; combinational and sequential logic circuits; multiplexer; Schmitt trigger; multi-vibrators; sample and hold circuits; A/D and D/A converters; 8-bit microprocessor basics, architecture, programming and interfacing.

Unit 5: POWER ELECTRONICS AND DRIVES

Characteristics and ratings of different thyristor family devices, their turn on and turn off methods with their protection, series and parallel connection of SCRs and their derating, Controlled single phase and three phase rectifiers for different types of load viz. R, R-L, R-L-E, single phase and three phase voltage source and current source inverter, cycloconverter, choppers, PWM techniques, Characteristics and principle of AC and DC machines, Methods of conventional controls and application of static controls and microprocessor based controls for AC and DC machines. Basic concepts of adjustable speed dc and ac drives.

Unit 6: Power Systems

Transmission line parameters; Representation of short, medium, and long transmission lines – ABCD parameters; Circle Diagram; Per Unit representation; 3-Φ system; Short Circuit Studies; Sequence Networks; Load-flow Studies – Gauss Seidel method, Newton-Raphson Method; Automatic Generation Control; Load-Frequency Control; Automatic Voltage Regulator; Power System Stability – Equal area criteria; Swing Equation; Optimal Load dispatch in Power System. Protection Schemes for Transformer, Generators and Transmission Lines.
ENG—English

Unit 1: Poetry
Shakespearean Sonnets, Milton’s Paradise Lost (Book I and IX), Wordsworth (Tintern Abbey) and Keats, (Nightingale, Grecian Urn, Psyche), Tennyson (Ulysses, Lotos Eaters), Eliot (Waste Land), Yeats (Byzantium, Easter 1916).

Unit 2: Drama
Shakespeare’s Tragedies, Dryden (All for Love), End Game (Samuel Beckett).

Unit 3: Fiction
Dickens (Tale of Two Cities and David Copperfield), Hardy (Mayor of Casterbridge, Return of the Native), Joseph Conrad (Heart of Darkness), R.K.Narayan (The Guide).

Unit 4: Literary Criticism
Coleridge (Biographia Literaria), Matthew Arnold (Study of Poetry), T.S.Eliot (Tradition and Individual Talent).

Unit 5: Language
Grammar, Basic English Phonology (Stress, Rhythm and Intonation), History of English Language (F.T.Wood), Spelling.

ECO—Economics

Unit 1: Micro Economic Analysis

Unit 2: Micro Economic Analysis

Unit 3: Macro Economic Analysis

Unit 4: Macro Economic Analysis

Unit 5: International Economic Analysis

HIN—HINDI

Unit 1: History of Hindi Literature (Hindi Sahitya ka Itihas)
Ancient and Medieval Period (Aadikal aur Madyakaal)

B) Modern Period (Adhunik Kaal)

Unit 2: Origin and Development of Hindi language and grammatical structure of Hindi
i. Pracheen bharatheeya aryabhashayemn- vedic thatha loukik sanskriti- madyakaleen, bhaatheeya aryabhashayemn – pali, prakrit- sourseni- apabramsh, ii. Hindi ke upbhashayemn – pashchimi Hindi, Poorvi Hindi, Rajasthan, Bihari tha-
Unit 3: Theory of literature (Literary criticism) - Indian and Western
A) Bharathee Kavyasastra
i. Ras sidhanth - ras ka swaroop - ras nishpathi - ras ka angu, ii. Alankar sidhanth - reethi sidhanth - vakrokti sidhanth - dwani sidhanth - pramukh sthapaneyemn
B) Paachathaya Kavyasastra

Unit 4: Official language Hindi and Functional Hindi

Unit 5: Journalism (Patrakarita)
Patrakarita –vibhinna prakar- Hindi patrakarita ka sankshipta Ithihas.

Unit 6: Linguistics
Phonology- phoneme and allophone, syntax – structure.

ITE—INFORMATION TECHNOLOGY

Unit 1: Engineering Mathematics
Discrete Mathematics
Linear Algebra
Matrices, determinants, system of linear equations, eigen values and eigenvectors, LU decomposition.
Probability
Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

Unit 2: Digital Logic
Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Unit 3: Computer Organization and Architecture
Machine instructions and addressing modes. ALU, data path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Unit 4: Programming and Data Structures
Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Unit 5: Algorithms
Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic spanning trees, shortest paths.

Unit 6: Theory of Computation
Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.
Unit 7: Operating System
Processes, threads, interprocess communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Unit 8: Databases
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.

Unit 9: Computer Networks

LAW

Unit 1: Legal Research Methodology

Unit 2: Constitutional Law
Important aspects of the Constitutional Law including leading cases on Constitutional Law.

Unit 3: Jurisprudence
Different Schools of Law - Critical analysis of law.

Unit 4: Criminal Law
General Principles of Criminal law.

Unit 5: Tort Law
Remedies available under Tort law with leading cases.

Unit 6: Emerging issues in Law
IPR, Cyber Law, International Law, Contracts, Labour and Industrial law and Administrative Law.

MAT—MATHEMATICS

Module – 1 Algebra: Permutations, combinations, pigeon-hole principle, inclusion exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler’s φ function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homeomorphisms, cyclic groups, permutation groups.

Matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Canonical forms, diagonal forms, triangular forms, Quadratic forms, reduction and classification of quadratic forms

Module – 2 Analysis Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation Metric spaces, compactness, connectedness

Module-3 Differential and Difference Equations:
Linear Ordinary Differential Equations (ODEs), variation of parameters, Sturm-Liouville problem. Partial Differential Equations (PDEs)-Classification of second order PDEs General solution of higher order PDEs with constant coefficients, Difference equations

Module-4 Transformation techniques – Laplace transformation – Fourier series – harmonics-Fourier transforms-z-transformation


Model-6 Descriptive statistics:

Module-7 Sampling Theory: Tests of hypotheses – Large and small sample tests confidence intervals. Chi-square test of goodness of fit. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. ANOVA

Module-8 Linear Programming: Formation of LPP – Simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.g

**MEG—MECHANICAL ENGINEERING**

**Unit 1:** Engineering Mathematics: Geometry Equations of straight line, common normal between straight lines in space; Equations of circles, ellipse, etc.; parametric representation.

**Unit 2:** Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Unit 3:** Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives.

**Unit 4:** Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Unit 5:** Control Theory: Open and closed loop systems; Laplace transforms; Transfer function; Block Diagram analysis; Concepts of stability; Input signals and system response; Nyquist stability criterion; Bode plot.

**Unit 6:** Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Permutations and combinations, Random variables, Poisson, Normal and Binomial distributions. Properties of normal curve; Statistical quality control

**Unit 7:** Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

**Unit 8:** Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr’s circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; thermal stresses.
Unit 9: Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; flywheels.

Unit 10: Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Unit 11: Technical drafting: Engineering drawing practice; Indian standards for technical drawing. Machine Elements Basic concepts of machine elements and their design; Stress concentration factor; Fatigue Strength and S-N curve; failure theories.

Unit 12: Fluid Mechanics: Fluid properties; viscous flow of incompressible fluids; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli’s equation; flow through pipes, head losses in pipes, bends etc.

Unit 13: Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, radiative heat transfer, black and grey surfaces, shape factors; heat exchanger performance, LMTD and NTU methods.

Unit 14: Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.


Unit 16: Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air psychrometric chart, basic psychrometric processes.

Unit 17: Turbo machinery: Pelton-wheel, Francis and Kaplan turbines, impulse and reaction principles, velocity diagrams.


Unit 19: Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

Unit 20: Forming: Load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

Unit 21: Joining: Physics of welding, brazing and soldering; adhesive bonding.

Unit 22: Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

Unit 23: Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Unit 24: Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Unit 25: Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Unit 26: Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

Unit 27: Mechatronics System Design: Pneumatic and hydraulic systems; Eletro-pneumatic and electro-hydraulic systems; Pneumatic, hydraulic and electric motors and actuators; Concepts of microcontrollers, Feedback devices; Point-to-point, continuous-path and servo control; Types of CNC machines and robots. Programmable logic controllers; CNC and robot programming. Some current developments in modern machine tools, robotics, mechatronics; Basic topics related to micro-electro mechanical systems (MEMS).

Unit 28: Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools. Exchange of product design and manufacturing data; CNC and robot programming methods. CAD/CAM Software and Virtual Product Development; Rapid Manufacturing Technologies; Concepts of Machine vision and Jigless manufacturing;
Unit 29: Computer Aided Engineering: Finite Element Methods; Computational Fluid Dynamics; Mechanical Systems Simulation; Tools for conventional mechanisms and MEMS design.
Unit 30: Automotive Engineering: Development in Bio-fuels, other alternative fuels and hydrogen as future fuel; Emission standards; Electronic injection systems; Passenger comfort and safety devices; Indian auto industry and Automotive vehicles in Indian market.

MGT—MANAGEMENT

Unit 1: Economics

Unit 2: Organizational Behavior and Human Resource Management

Unit 3: Information Technology
Foundations of Information Systems- IT Applications in Business- ERP- CRM- SCM and E-Commerce.

Unit 4: Accounting &: Financial Management

Unit 5: Statistics, Production and Operation Research

Unit 6: Business Research Methods

Unit 7: Marketing

Unit 8: Strategy
Strategic Management- Vision- Mission- Objectives- Environmental analysis- Strategy formulation- Corporate Level-SBU Level- Functional Strategies- Strategy implementation. Corporate Governance: Procedures and Principles, Governance Reforms in India - Business Ethics: Ethics and Management System; Ethical issues and Analysis in Management; Value based organisations; Personal framework for ethical choices; Ethical pressure on individual in organisations; Gender issues; Ecological consciousness; — Corporate Social Responsibility.

Unit 9: International Business

Unit 10: Entrepreneurship
NBT—NANO-BIOTECHNOLOGY

Unit 1: Biophysics
Levels of structures in Biological macromolecules. Basic strategies in biophysics. Forces that determine protein and nucleic acid structure, Prediction of proteins structure nucleic acids, Properties of lipid bilayers, Biochemical Kinetics studies, unimolecular reactions, methods of determining macromolecular structures inclusive of the spectroscopic techniques like UV-visible absorption, IR absorption, circular dichroism, fluorescence, NMR and X-ray and neutron diffraction techniques.

Unit 2: Cell Structure and Function of the Organelles
Eukaryotic and Prokaryotic cells, cell division, mitosis & meiosis cell cycle and molecules that control cell cycle, endocytosis and Exocytosis. Ultrastructure of cellular organelles, viz. Mitochondria, ER, Golgi, Chloroplast, plasma membrane, centriole, nuclear and membrane bound receptors, Signal Transduction, Techniques of propagation of prokaryotic and Eukaryotic cells, Autocrine, Paracrine and Endocrine models of action, Cell line, generation of cell lines.

Unit 3: Molecular Biology
Structure of DNA and histone molecules, Replication of eukaryotic chromosomes, nucleoid the complex replication apparatus, process of transcription and, Structure of tRNA, mRNA, rRNA, Deciphering of the genetic code, Translation, Mutation. General principles of cloning.

Unit 4: Recombinant DNA
Genetic elements that control gene expression, method of creating recombinant DNA molecules creating transgenic animals, plants microbes, safety guidelines of creating recombinant DNA research, restriction enzymes and mapping of DNA, plasmid and phage and other vectors. Construction of genomic and cDNA libraries, methods of nucleic acid. Patents and methods of application of patents, legal implications bioremediation. Ecosystems, energy flow, ecological succession, pollution, Conventional and Non conventional sources of energy, Bio-geo chemical cycles, Biodiversity and wild life conservation, Social issues and the environment.

Unit 5: Genetics
Classical genetics, Mendel’s genetics, crossing over, linkage, Chromosome maps, chromosomal theory of heredity, cytoplasmic inheritance, Sex determination, sex linked inheritance, microbial genetics, population genetics, polyploidy, pedigree analysis, eugenics, mutation.

Unit 6: Microbiology
Basic concepts of Microbiology, classification, morphology, anatomy, physiology of bacteria, viruses, fungi, parasite. Microbes of various plant and animal diseases. Industrial microbiology, Microbial biotechnology, Microbial diversity and ecology.

Unit 7: Immunology
Basic concepts of immunology, types of immunity, biotechnological applications; organs of immune, response Innate and adaptive immunity, clonal selection theory, hypersensitivity, hybridoma technology, vaccine development, epitope mapping and immunomics, immunological tolerance and transplantation biotechnology.

Unit 8: Plant Sciences
Taxonomy and systematic botany, Plant structure and development, morphology and anatomy, embryogenesis of mono and dicots. Phytohormones, respiration, nutrition, transpiration. Photosynthesis,C3 and C4, & CAM plants, photoperiodism, concepts of ecosystems and energy flow in biosphere.

Unit 8: Nanobiosciences
Definition of Nanoscale; Physical and Chemical Properties of Materials in the Nanoscale; Biological systems at Nanoscale; synthesis of nanomaterials: top down and bottom up approach; Optical Properties: Surface Plasmon resonance, and SERS; Microscopy at nanoscale: SEM, TEM, AFM, STM; nano-emulsion and applications; Nanoparticle interactions with cells, biomolecules, immune system; cytotoxicity and cellular responses; biocompatibility; abetting nanotoxicity; Ecotoxicology and environmental impacts.
NTY—NANOTECHNOLOGY

Unit 1: Quantum Physics
Basics of Quantum Physics, de Broglie’s wavelength, Heisenberg’s uncertainty Principle, Quantum Mechanical Eigen Value Equation, Quantum Mechanical Operators and Time Dependent and Time Independent Schrodinger Wave Equations, Particle in 1D and 2D box.

Unit 2: Electromagnetics and EM Waves
Coulomb’s law, Lorentz Force and motion of charged particles in electric and magnetic fields. Maxwell’s equations. Eigen value representation of Maxwell Equation, TM, TE and TEM waves.

Unit 3: Solid State Physics
Types of bonding, Crystal structure, Bravais lattices, Miller indices, free electron theory of metals. Fermi energy and density of states, origin of energy bands, concept of effective mass of holes and electrons. Energy levels in One Dimension, Fermi-Dirac and Bose-Einstein Distributions and effect of Temperature in these. Concept of Chemical Potential. II-IV, III-V and Group IV semiconducting materials, periodic lattice and Bloch theorem.

Unit 4: Semiconductor Devices

Unit 5: Nanostructures
0D, 1D, 2D nanostructures, Density of states. Magnetic, Electrical, Optical and thermal properties of nanomaterials. Change in characteristics from bulk to nanoscales.

Unit 6: Fabrication/Growth of Nanostructures
Top-down and Bottom-up approaches for Nanomaterial synthesis,- Physical, chemical and biological routes. Thin film growth- Chemical Vapor Deposition, Physical Vapor Deposition, Self-Assembly. Lithography- Optical & Electron Beam Lithography.

Unit 7: Characterization
Electron microscopes, scanning electron microscopes, transmission electron microscopes, scanning probe microscopy, atomic force microscopy, scanning tunneling microscope, Spectroscopy- FTIR, UV-Vis, Raman, NMR, XRD.

PHY—PHYSICS

Unit 1: Mathematical Methods of Physics
Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigenvalue problems; Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis: Laurent series-poles, residues and evaluation of integrals; Elementary ideas about tensors; Introductory group theory, SU(2), O(3); Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson’s rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

Unit 2: Classical Mechanics
Newton’s laws; Phase space dynamics, stability analysis; Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudoforces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass-energy equivalence.

Unit 3: Electromagnetic Theory
Electrostatics: Gauss’ Law and its applications; Laplace and Poisson equations, boundary value problems; Magneto-statics: Biot-Savart law, Ampere’s theorem, electromagnetic induction; Maxwell’s equations in free space and linear
isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel’s Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell’s equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials.

**Unit 4: Quantum Mechanics**

Wave-particle duality; Matrix representation; Dirac’s bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Time-independent perturbation theory and applications; Variational method; Time dependent perturbation theory and Fermi’s Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli’s exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

**Unit 5: Thermodynamic and Statistical Physics**

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First- and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck’s distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to nonequilibrium processes; Diffusion equation.

**Unit 6: Electronics**

Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronic devices, including solar cells, photodetectors, and LEDs; High-frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics.

**Unit 7: Experimental Techniques and data analysis**

Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signal conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; Fourier transforms; lock-in detector, box-car integrator, modulation techniques. Applications of the above experimental and analytical techniques to typical undergraduate and graduate level laboratory experiments.

**Unit 8: Atomic & Molecular Physics**

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

**Unit 9: Condensed Matter Physics**

Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Bonding of solids; Elastic properties, phonons, lattice specific heat; Free electron theory and electronic specific heat; Response and relaxation phenomena; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power; Diamagnetism, paramagnetism, and ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors;
Superconductivity, type I and type II superconductors, Josephson junctions; Defects and dislocations; Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order; Conducting polymers; Quasicrystals.

Unit 10: Nuclear and Particle Physics
Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semiempirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge independence and charge-symmetry of nuclear forces; Isospin; Deuteron problem; Evidence of shell structure, single-particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity nonconservation in weak interaction; Relativistic kinematics.

PSY—PSYCHOLOGY

Unit 1: Introduction to Psychology- Definition, Nature and Scope of psychology; Historical perspective; subfields and applications, methods of psychology; Schools of Psychology.
Unit 1: Sensation and Perception, Learning, Memory Building, Cognition Process, Intelligence, Motivation and Emotion, Personality and its Types, Individual Differences and the impact of the process of Socialization, Environmental influences and Counseling therapy.
Unit 4: Research Methodology – Meaning, Aims, characteristics and types, Research Process, types of Research Design, Sampling, types and uses, Research Hypothesis, Methods of Data Collection, Tools and Techniques of data collection, Psychological Scaling, Sources of bias in Psychological testing, Data Analysis and Report writing.

SOY—SOCIOLOGY

Unit 1: Introduction to Sociology - Origin and Development of Sociology, Meaning of Sociology, Nature and Scope, Sociology as a Science, Relationship with Other Social Sciences.
Unit 3: Sociological Perspectives – Evolutionalism, Functionalism, Marxism, Structuralism, Interactionism, Phenomenology and Ethnomethodology, Post Modernism, Neo Marxism, Neo structuralism.
Unit 1: FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS
Current trends in automotive electronic control system, electro- magnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

Unit 2: SENSORS AND ACTUATORS
Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application.

Principles of actuation and control - DC motors, stepper motors, Relays and solenoids, Hydraulic and pneumatic.

Unit 3: Automotive Engines
Engine types and operation, Subsystems of automotive engines, Fuel system: Carburetion, Ignition systems, Fuel delivery systems, Engine control functions, Fuel control, Calculation of injector pulse width and injection strategies, Ignition
Timing control, Lambda control, Engine control modes, Engine control diagnostics, Cooling system, Cooling system requirements, Radiator, Fan, Water pump, Turbo charging, Supercharging, Heat Exchanger.

**Unit 4:** Transmission control, Braking & Electronic Stability Control and Steering Control


**Unit 5:** Embedded Controller for Automotive and Serial communication protocol on Microcontroller

Peripheral Interfacing with 16-bit Micro-controller -Timer, parallel port programming, Stepper motors, LCD, Keyboard, Serial Port, ADC, DAC, & Sensor Interfacing, Interrupt handling, PWM generation, DC motor control, Automotive embedded system application development using IO and related programming.

UART, SPI, I2C, Various ways to use the CAN module in HCS12, interfacing using LIN, Micro-controller based system development using IO and related programming.

**Unit 6:** Data Acquisition System and Interfacing

Interfacing issues with DAS boards - Data acquisition method with time-division channeling, space-division channeling, and main errors of multi channel data-acquisition systems, data transmission and error protection, Bus standard for communication between instruments - GPIB (IEEE-488bus) - RS-232C- USB -4- to-20mA current loop -serial communication systems -Communication via parallel port –Interrupt based Data Acquisition.

**Unit 7:** Basics of Data Communication Networks and Automotive Communication Protocols and Telematics basics, applications and technologies:


**Unit 8:** BATTERIES AND ACCESSORIES

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging.

Lighting system:
insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system

**Unit 9:** STARTING SYSTEM and Charging systems

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.
Requirements of charging systems -generation of electrical energy in motor vehicle –physical principles -alternators -characteristic curves -charging circuits -diagnosing charging system faults -advanced charging system technology -new developments.

**Unit 10:** Ignition Systems and Lighting & accessories

Fundamentals -electronic ignition -programmed ignition –distributor less ignition –direct ignition spark plug ignition -diagnosing faults -advanced technology, Insulated and earth return systems, positive and negative earth systems, details of head light and side light, head light dazzling, and preventive methods. Electrical fuel pump, speedometer, oil and temperature gauges, horn, wiper system.
COMMON FOR SYLLABUS ALL SUBJECTS  
(15% EACH)

ENGLISH COMMUNICATION

1. Grammar
   Subject – Verb Agreement
   Tense forms
   Voices
   Articles and Preposition
   Use of Conjunctions
2. Writing Technical Instructions
3. Writing Memos & Writing Minutes
4. Transcoding
5. Preparing Questionnaire
6. Proof Reading

STATISTICS & PROBABILITY

**Unit 1: Statistics**
Definitions, Scope and Limitations - Sampling methods - Collection of data-Classification and Tabulation - Frequency distribution - Diagrammatic and graphical representation - Measures of Central Tendency - Mean, median, mode Partition values (Median, quartile, Deciles and percentiles)- Measures of Dispersion- Coefficient of variation- Skewness and Kurtosis.

**Unit 2: Correlation- and regressions**
Scatter diagram-Coefficient of correlation – Rank correlation- Lines of linear regression – Partial correlation-multiple correlation - Multiple linear regressions.

**Unit 3: Probability**

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