

Ph.D. PROSPECTUS: 2018-19 (Even Semester)

Ph.D. PROGRAMMES, SLOTS AND ELIGIBILITY

Deenbandhu Chhotu Ram University of Science & Technology, Murthal offers research programmes in its Departments/Centers leading to the award of Degree of Doctor of Philosophy (Ph.D.). The award of Ph.D. degree is in recognition of high academic achievements, independent research and application of knowledge to the solution of technical and scientific problems in Science, Technology, Architecture, Management and Humanities. The procedure and requirements spelt out in Ordinances and Regulations embody the philosophy to ensure high standards of performance in research work at the University. Notwithstanding these Ordinances and Regulations, various Departments and Centers may require the candidates to complete additional requirements so as to serve their particular academic goals. Ph.D. degree of Deenbandhu Chhotu Ram University of Science & Technology, Murthal shall be conferred on a candidate who fulfills the requirements specified in the Ordinances and Regulations.

1. ELIGIBILITY CRITERIA FOR ADMISSION

- 1.1. Candidates for admission to the Ph.D. programme must have a Master's degree in the relevant discipline or a professional degree declared equivalent to the Master's degree in the relevant discipline by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions.
- 1.2. A relaxation of 5% of marks, from 55% to 52.25%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/BC(non-creamy layer)/Differently-Abled and other categories of candidates as per the decision of the Commission from time to time, or for those who had obtained their Master's degree prior to 19th September, 1991. The eligibility marks of 55% (or an equivalent grade in a point scale wherever grading system is followed) and the relaxation of 5% to the categories mentioned above are permissible based only on the qualifying marks without including the grace mark procedures.

2. DURATION OF THE PROGRAMME

2.1. Ph.D. programme shall be for a minimum duration of three years, including course work and a maximum of six years. For further details, refer Ph.D. ordinance.

3. ADMISSION PROCESS

3.1. Admission notice seeking applications for Ph.D. programme shall be issued once or twice in a year.

3.2. Numbers of seats (Slots) available for admission in different Departments are given below.

Sr. No.	Name of the Department	Slots
1.	Biotechnology	08
2.	Biomedical Engineering	01
3.	Civil Engineering	03
4.	Computer Science & Engineering	10
5.	Electrical Engineering	14
6.	Electronics & Communication Engineering	19
7.	Mechanical Engineering	26
8.	Physics	18
9.	Chemistry	05
10.	Materials Science and Nanotechnology	02
11.	Energy and Environment Studies (CEEES)	02
12.	Chemical Engineering	05
13.	Management	10
14.	Architecture	07

3.3. **Haryana State reservation policy will be followed to distribute the total number of slots and is subject to any change / amendments by the State Governments from time to time.**

DISTRIBUTION OF SLOTS FOR Ph.D PROGRAMMES

AIC (All India Category)	: 15% of the total slots
State Quota	:85% of the total slots
Haryana Open General Category (HOGC)	:HOGC 50% of State Quota i.e. 42.5% of total slots
Reserved Categories of Haryana	:50% of State Quota i.e. 42.5% of total slots
Scheduled Castes of Haryana SC	:20% of State Quota (17% of total slots)
Backward Classes of Haryana (A) BCA	: 16% of State Quota (13.6% of total slots)
Backward Classes of Haryana (B) BCB	:11% of State Quota (9.35% of total slots)
Physically Handicapped PH	: 3% of State Quota (2.55% of total slots)

Note:-

- i. While calculating the slots (distribution of slots), 0.5 or higher correction may be raised to the next higher whole number.
- ii. Only the candidates having the permanent disability of not less than 40% (being otherwise fit for admission of the course) will be considered for admission as physically handicapped. Disability certificate must be issued from Chief Medical Officer of the concerned District.
- iii. In the event of quota reserved for physically handicapped remain unutilized due to non availability for suitable category of handicapped candidates, it may be offered to the Ex-Serviceman and their wards (1%) and the dependents of Freedom Fighters (1%).
- iv. Vide Notification No. 808-SW (1) dated 17 August, 2016 issued by Welfare of Scheduled Castes and Backward Classes Department, Haryana, the criteria for exclusion of creamy layer within the Backward Classes as per the Schedules appended to the Act, namely Scheduled I, II & III will be as under:-

“ The Children of persons having gross annual income of upto three lakh rupees shall first of all get the benefit of reservation in services and admission in educational institutions. The left out quota shall go to that class of Backward Classes of citizens who earn more than Three Lakh rupees but upto Six Lakh rupees per annum. The sections of the Backward Classes earning above Six Lakh rupees per annum shall be considered as Creamy Layer under section 5 of the said Act.”

- 3.4. The candidate seeking admission shall apply to the University online.
- 3.5. The applicants will have to take the Entrance Test and those further shortlisted will be required to appear for interview. Candidates who have valid **JRF** (UGC / CSIR / DBT / any other through an Entrance Test) / GATE / NET are exempted from the Entrance Test. However, candidate covered under the exempted categories may also appear in the entrance test, if they so desire, to improve their weightage (Refer Clause 3.11.)
- 3.6. Candidates who are exempted from the Entrance Test in Clause 3.5 may also approach the Departments or Centres round the year to apply for admission to Ph.D. programme except during the period of process of Ph.D admission (from the date of advertisement to the date of final admission). The respective DRC/CRC may interview the applicant to take a decision. If, selected, the applicants will be admitted to research programme and will have Pre-Ph.D. course in the same or subsequent semester(s).
- 3.7. In the Entrance Test, the candidate has to secure atleast 50% marks in case of General Category. A relaxation of 5% of marks (from 50% to 45%) shall be allowed for the candidates belonging to SC / BC (Non-Creamy layers) / Differently-abled category in the entrance examination conducted by the University. Minimum qualifying marks do not guarantee the admission. Final admission shall be made on the basis of criterion prescribed in Clause 3.11.

3.8. The Entrance Test shall be a Single Paper Test having 100 Multiple Choice Questions (MCQs) and duration of test shall be 120 Minutes. The candidates shall be required to answer all questions. There will be no negative marking for wrong answers. The Entrance Test shall be divided in two parts.

(a) Part 'A' Research methodology

Part-A shall consist of 50 MCQs each carrying one mark. The questions which will be of general nature, intended to assess the teaching / research aptitude of the candidate. It will primarily be designed to test reasoning ability, comprehension, divergent thinking and general awareness of the candidate (**Sample copy of the paper is attached**).

(b) Part 'B'

This part shall contain 50 subject specific MCQs covering the topics given in the syllabus and are designed to test a candidate's knowledge of subject in which he/she has applied for Ph.D. admission.

3.9. The successful applicants, i.e. eligible applicants, who qualify the Entrance Test or otherwise exempted under Clause 3.5 shall be judged by the Department Research Committee (DRC) through interview/viva-voce/presentation.

3.10. The interview/viva-voce/presentation shall also consider the following aspects, viz. whether:

- a) the candidate possesses the competence for the proposed research;
- b) the research work can be suitably undertaken at the department/centre;
- c) the proposed area of research can contribute to new/additional knowledge.

3.11. The DRC after due assessment of the candidate's competence for the proposed research, area of research and its contribution to knowledge and also taking due note of vacancy available in the research area will prepare a merit list.

While preparing the merit list, weightages shall be given according to the following criteria:-

- i. 25% for the marks in the Master's Degree examination.
- ii. 15 % for the marks in the Bachelor's Degree examination.
- iii. 40% for the marks in the Entrance Test.

OR

30 marks to those candidates who have qualified valid **JRF** (UGC / CSIR / DBT / any other through an Entrance Test).

OR

20 marks to those candidates who have qualified valid GATE / NET.

However, candidate covered under the exempted categories may also appear in the entrance test, if they so desire, to improve their weightage.

- v. 20% for the marks in the seminar/presentation/interview to be conducted by the respective DRCs/ CRCs.

Note: The merit of the candidates who are availing weightage of valid JRF (UGC / CSIR / DBT / any other through an Entrance Test) / GATE / NET will be considered in the category in which they were issued certificate by UGC / other equivalent agencies or in their own category.

Number of vacant slots may be decreased depending on the suitability of applicants.

- 3.12. In every case, the Department/Centre will have disciplinary and general control over the research students.
- 3.13. The DRC will verify the eligibility conditions and other required documents with originals before allowing him/her to give presentation before DRC. The recommendation of DRC including merit list shall be approved by Dean Academic Affairs. On the basis of above recommendations, Academic Branch will issue the admission letters to the candidates within a week and candidate has to deposit his/her fees as per instructions given in admission letter. The date of reporting in the Department/Centre concerned shall also be specified in the admission letter.
- 3.14. The list of admitted candidates will be put before the forthcoming meeting of the Academic Council to take a note and for ratification of the selections made and admitted candidates.

4. PRE Ph.D. COURSE WORK

The admitted candidates will be allowed to register for Pre-Ph.D. Courses after their admission.

4.1 COURSE WORK AND CREDITS

All research students shall have to complete the specified course work as per the academic semester schedule. Details are given in Ph.D. ordinance.

5. ONLINE FILLING OF APPLICATION FORM

The candidate seeking admission shall apply to the University online.(link is available on the university website www.dcrustm.ac.in / dcrustadmission.org)

- Please keep your scanned photograph, saved in a file in jpeg format, ready to upload on the application form. The file size should be between 20 kB to 40 kB.
- Please keep your scanned signature, saved in a file in jpeg format, ready to upload on the application form. The file size should be between 10 kB to 20 kB.

Please read the instructions given below to complete and submit the Online Application

form:-

- a. Check eligibility for admission to a programme of your choice by clicking on the 'Programme and Eligibility Details' tab.
- b. Keep details of your qualification from matriculation onwards ready.
- c. All the details required in the Online Application form should be filled in.
- d. Last date for submitting the duly completed application along with the required application fee is 19.11.2018 up to 11.59 P.M. (mid night).
- e. Application fee must be paid online through "Pay Fee" link which is activated after the application form is completed and submit button is clicked. Application fee to be paid is:-
General category and all others: (₹) 1000.00 (One Thousand Rupees only)
SC/BC candidates of Haryana only: (₹) 250.00 (Two Hundred Fifty Rupees only)
- f. After submitting the Online Application, the registration number and password will be generated.
- g. Note down the registration number and password for future reference. These will be required for admission test (if applicable).

h. Fees once paid shall not be refunded / transferred.

6. ENTRANCE TEST & SYLLABI

6.1 Candidates seeking admission to Ph.D. programme shall have to appear in the Entrance Test. The eligible applicants will have to qualify the prescribed Entrance Test meant for registration to Ph.D. programme. For details information see Clause 3. ADMISSION PROCESS.

6.2 Entrance Tests for admission to various Ph.D. programme shall be conducted at University level on the basis of prescribed syllabi of concerned discipline.

6.3 A candidate can apply for admission to one department/discipline only. The entrance test will be held at the University Campus as per the schedule.

6.4 Syllabi for Entrance Test

- In case of Physics and Chemistry the syllabus shall be of CSIR-NET-2018
- In case of Management ,the syllabus shall be of UGC-NET-2018
- In case of Biomedical Engineering, Energy & Environment Studies and Material Science and Nano Technology, the syllabus is given in Annexure-A
- In case of disciplines (Computer Science & Engg. /Electronics & Communication Engg./ Electrical/Mechanical/Biotechnology/Chemical/Civil/Architecture) on the basis of GATE -2018 syllabi.

6.5 The entrance test shall be a single paper test of 120 minutes duration consisting of 100 multiple choice questions. The candidates shall be required to answer all questions.

6.6 There shall be no negative marking.

6.7 Important Instructions to the candidates for appearing in Entrance Test

- i. The Candidate must bring his / her Admit Card for appearing in the test.
- ii. The Candidates will be provided with computer system in case of online examination and question booklet alongwith OMR Sheet for offline examination.
- iii. In case of online examination, the Candidates are advised to contact the HELP DESK at University Computer Centre, Saraswati Library Building, DCRUST Murthal, at least 30 minutes before the scheduled start of examination to get their computer system location. (The venue of examination shall be notified on the university website/admit card).
- iv. No candidate will be allowed to take the entrance examination 15 minutes after the scheduled start of examination.
- v. The Candidates should NOT tamper with the computer system /questions booklet/OMR sheet in any form which may lead to disqualification.
- vi. Mobile Phones/Blank Papers/ Clip Boards/Log Tables/Pagers and any other Electronic Gadget, are not allowed in the Examination hall. However, scientific calculator is allowed.

- vii. The Possession of Books, loose papers, written notes, and/or adoption of unfair means/impersonation / misconduct during the examination shall automatically lead to cancellation of the candidature.
- viii. In case of online examinations, the Candidates shall be provided with A4 sheet for rough work which is to be handed over to the invigilator before leaving the Examination hall at the end of the test.
- ix. The candidates shall bring any of his identity proof with photograph such as Driving License, Pan Card, Passport, Voter Card, Aadhar Card etc. at the time of entrance test.
- x. Candidates with valid JRF (UGC/CSIR/DBT/any other through entrance test) need not to appear in the entrance test.

7. FEE STRUCTURE/FEE CONCESSION/SCHOLARSHIP

The fee structure for Ph.D. programme 2018-19 (Even Semester) will be as under:

Sr. No.	Type	Indian Students (₹)	Foreign Students (USD)	DCRUST Employees and their dependents (₹)
1.	Semester fees (non-refundable)	10000/-	1500/-	5000/-
2.	Admission and development fees (Non-Refundable) (One-time payment to be paid at the time of admission)	10000/-	1000/-	7500/-
3.	Security deposit (refundable) (to be paid at the time of admission)	5000/-	500/-	5000/-
	TOTAL (to be paid at the time of admission)	25000/-	3000/-	17500/-

Notes:

- i. The fees include Tuition Fee, Examination Fee, University and Student Fund Charges etc. However, Hostel fees will be charged separately.
- ii. No other concession, of any kind, will be admissible to the DCRUST employees and their dependents.
- iii. The Semester Fees will be payable up to the semester in which the viva voce is conducted.
- iv. The cut of date of refund of fee for the candidates admitted in pre Ph. D course work will be one month after the commencement of classes for pre Ph.D Course. ₹1,000/- will be deducted as a processing fee.

8. SCHOLARSHIPS

8.1 UNIVERSITY SCHOLARSHIP/ASSISTANCE-SHIP

University Scholarship/Assistance-ship by the University will be offered to the Topper of Pre Ph.D course work done in the University provided the candidate is not availing any other scholarship. In case two or more candidates have same highest SGPA in course work then topper shall be decided by existing rule to award Gold-Medal to break the tie.

8.2 OTHER SCHOLARSHIPS

The students can avail the Scholarships granted by other organizations like UGC, AICTE / TEQIP etc.

9. COUNSELING AND ADMISSION

9.1 The final eligibility of candidates shall be determined at the time of presentation/interview before Departmental Research Committee to be conducted by the respective departments and accordingly the admissions shall be made as per Ph.D. ordinance.

9.2 The admission to Ph.D. programme shall be open to the candidates having qualifying degree examination in any relevant discipline from any Indian University included in the approved list of Association of Indian Universities (AIU) or any foreign university recognized by AIU or any other central Govt. institution.

Note: Candidates shall bring **Two sets** of attested/Self attested copies of following documents (as applicable) at the time of counseling/presentation along with print out of online filled application form (as applicable) for admission in Ph.D. Programmes.

- Fee receipt.
- Three Passport size photographs.
- Certificates showing the detailed marks / grades in all subjects in the qualifying examination
- Matriculation/Hr. Secondary Examination Certificate as proof of age.
- Conversion Table/Formula showing equivalence between percentage and CGPA of the qualifying degree.
- Valid JRF score card (wherever applicable).
- Medical Fitness Certificate from a Gazetted Medical Officer.
- Character Certificate (Annexure I).
- For gap period, if any, the candidate will submit an affidavit from the notary / first class magistrate certifying his/her good conduct.
- Haryana Resident Certificate (Annexure II).
- Certificate from the Employer (Annexure-III)
- SC/BC/PH/FF/DFF/ESM (Annexure -IV, V, VI, VII, VIII, IX, X).

- Declaration by parents (Annexure XI).
- Sponsorship and Relieving Certificate (Annexure XII, XIII)
- Income certificate from competent authority (Annexure-XVI)

Note: Please refer University Brochure for format of above Annexures.

10. SCHEDULE OF EVENTS

Schedule of events for Ph.D. admission 2018-19 (Even semester)

S. No.	Event	Date
1	Start of Online submission of form	31 st October 2018
2	Last date for online submission of forms	26 th November 2018
3	Availability of admit cards on the website	29 th November 2018
4	Entrance test examinations	3 rd December 2018
5	Declaration of result	06 th December 2018
6	DRC meetings*	10 th - 17 th December 2018
7	List of admitted candidates	24 th December 2018
8	Last date for deposition of fee	31 st December 2018
9	Start of Pre Ph.D. course work classes	07 th January 2019

*Department wise DRC meeting schedule will be uploaded on the website separately.

Note:

1. The date & time of entrance examination printed on Admit Card shall be final and admit cards shall be made available on login portal of the candidates.
2. Result of the entrance test shall be displayed on the website of the university / login portal of the candidate.

11. GENERAL INSTRUCTIONS, CODE OF CONDUCT AND ANTI-RAGGING GUIDELINES AND MEASURES, ABOUT THE UNIVERSITY, DEPARTMENTAL INFORMATION, ACADEMIC CALENDAR ETC : REFER UNIVERSITY BROCHURE AVAILABLE ON THE UNIVERSITY WEBSITE.

Note : Any doubt or dispute about the interpretation of this prospectus or the Regulations shall be referred to the Vice Chancellor whose decision shall be final.

Annexure-A

SYLLABI FOR ENTRANCE TEST

For the subjects/courses where JRF/NET/GATE examination is not conducted the syllabi is as under:

BIOMEDICAL ENGINEERING

Human Anatomy and Physiology: Structure and functions of cell. Polarization and depolarization of cell, tissue structure and functions, Redox potentials and Oxidative phosphorylation, Transport of substances across biological membrane function, Acid and base balance, Composition and functions of nucleic acids and Blood, Genes, Outlines of DNA structure, Recombinant DNA and its applications, Enzymes, Cardiovascular system, Respiratory system, Elementary system, Central Nervous system, Reproductive system, Urinary system, Muscular System, Endocrine system, Sense organs: Eye, Ear, Integumentary system (skin study).

Fundamentals of Electronics and Electrical Engineering: A.C. and D.C. circuits, Transient Response, Network Theorems, Series and Parallel A.C. Circuits, Three Phase Circuits, Transformers, Electrical Machines, Measuring Instruments, Network Topology, Loops and Nodes, Network Theorems, Resonant Circuits, Transient behavior, Laplace transformation and its application, Two port network parameters, Semiconductor Materials and Diodes, BJT Amplifiers, FET Amplifiers, Frequency Response of Amplifiers, Power Amplifier, Differential Amplifiers, Feedback and Stability, Operational Amplifiers, A/D and D/A Converter, Basic Digital Circuits, Number System And Codes, Combinational Circuits, Sequential Circuits, Digital Logic Families, Modulation: AM, PM, FM, PAM, PDM, Noise Analysis

Biomaterials and Artificial Organs: Biomaterials and their Classification, Properties of different biomaterials, characterization of biomaterials using techniques like DSC, FTIR, TEM, SEM, Material sterilization and testing, Developmental aspects of artificial organ.

Biomechanics and Rehabilitation Engineering: Biomechanics, Kinesiology, Kinematics and Dynamics of Motion, Mechanics of Hard Tissue, Musculoskeletal Soft Tissue Mechanics, Cochlear Mechanics, Vestibular Mechanics, Mechanics of Heart, Lungs, Blood Vessels, Heart Valves, Gait Terminology, Analysis of Gait, Exercise Physiology, Factors Affecting Mechanical Work in Humans, Upper Limb prosthesis, Lower Limb prosthesis, Spinal Orthosis, Neural Prosthesis, Introduction to Rehabilitation, Sensory Rehabilitation- Tactual, Auditory, Visual, Speech.

Microprocessors and Microcontrollers for Medical Instrumentation: Introduction, Architecture, Instruction Sets and Applications of 8085, 8086, 8259, 8237, 8051 to medical instrumentation

Biomedical Sensors and Bioinstrumentation: Bio-sensors and transducers: electrodes, optical sensors, analytical sensors, Generalized Instrumentation: Systems design and development, static and dynamic characteristics, Bio-instrumentation: clinical laboratory instruments, imaging instruments, bio-potential recorders, bio-feedback instruments, bio-impedance analysis, patient

monitoring systems, Anesthesia machine, spirometer, haemodialysis machine, surgical diathermy, Fiber Optics and Laser in medicine, Device Safety

Biomedical Signal and Image Processing: Biosignals and their characteristics, Time-domain modeling, Digital signal processing techniques, Data reduction techniques, Generation and detection of X-rays, Principle and theory of CT scanning, PET, SPECT, Gamma Camera, NMR imaging, Ultrasound Imaging, Elements of digital image processing systems, Image transforms, image reconstruction techniques.

Biomedical statistics: Descriptive and Summary statistics, Elements of Probability, Hypothesis testing, Survival analysis, Analysis of Variance and Co-variance, Statistical Quality Control, Random variables and theoretical distributions, Linear Programming problems, Regression and Correlation, Mathematical modeling and Solution of biomedical problems.

Biological Control Systems: Concept Of Transfer Function, Signal Flow Graphs, Root Locus Technique, Time and Frequency Domain Analysis, Transient and Steady State Response Of Systems, State Variable Analysis Of Control Systems, Transformation To Phase Variables Canonical Forms Of State Variables, Controllability and Observability, Biological Control System: Pupil Control Systems, Thermoregulatory Control Systems, Modeling The Body As Compartments, Biological Receptors, Respiratory Model and Systems, Cardiovascular Control System, Skeletal Muscle Servomechanism.

Medical Informatics and Telemedicine: Introduction to medical informatics, review of computers and informatics, structure of medical informatics, Classification of medical data and information, development of database management system for a hospital environment, Security issues in computer and internet , Computers in Clinical Laboratory, Nursing Information Systems, Computers for Critically ill, Role of Telemedicine in healthcare, current applications of Telemedicine, computer assisted drug delivery

Tissue Engineering and Bio-nanotechnology: Basic Immunology, Wound Healing Process, Scaffolds and Their Properties, Animal Cell Culture On Scaffolds, Nanoparticle Synthesis And Properties, Nanosensors, Nanoparticles for Drug Delivery.

Soft Computing Methods: Artificial Neural Networks, Fundamentals of Genetic Algorithms, Introduction to Fuzzy Systems, Neuro-Fuzzy Systems, Introduction to Soft Computing Simulation Tools, EMI/EMC with MATLAB Simulations.

ENERGY AND ENVIRONMENT STUDIES (CEES)

Energy and Environment Relationship: Basics of Clean Energy Sources, Conventional and Non-Conventional Energy Sources, Problems to Environment from These Sources, Quality and Quantity of Their Magnitude, Comparative Study of Different Pollution Problems in Our Country, Future Scenario of Environmental Degradation Due To Conventional Sources.

Classification of Energy Sources: Principle fuels for energy conversion: Fossil fuels, Nuclear fuels. Conventional and Renewable Energy, Energy Sources: prospecting, extraction and resource assessment and their peculiar characteristics, Direct use of primary energy sources, Conversion of primary into secondary energy sources such as Electricity, Hydrogen, Nuclear energy etc, Energy Conversion through fission and fusion, Nuclear power generation etc.

Basics of Thermodynamics: Basic Units, Dimensions and Conversions For Energy, Concepts of Energy, Heat and Work, Ideal gas law, Ist and IInd law of thermodynamics (Closed and Open

Systems) Thermodynamics power cycles, Reversible heat Engine cycle, I.C. engine cycles, Carnot Cycle, Rankin Cycle, Otto Cycle, Vapor Refrigeration and power Cycle etc.

Solar Energy: Nature of Solar Radiation, Global, Beam and Diffuse Radiation, Hourly, Daily and Seasonal variation of solar Radiation, Estimation of Solar Radiation, Measurement of Solar Radiation, Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy and Environment, Various Methods of using solar energy –Photo thermal, Photovoltaic, Photosynthesis, Present and Future Scope of Solar energy. Basics of Semiconductors Physics: Intrinsic and Extrinsic Semiconductor, Direct and indirect transition, inter-relation between absorption coefficients and band gap recombination of carriers.

Basics of Photovoltaic Technology: Types of Solar cells, crystalline silicon deposition techniques, description and principle of working of single crystal, polycrystalline and amorphous silicon solar cells and new materials for solar cells applications.

Hydrogen Energy: Hydrogen as a renewable energy source, Sources of Hydrogen, Fuel for Vehicles, Hydrogen Production: Direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production. Storage of Hydrogen: Gaseous, Cryogenic and Metal hydride, Structural characterization of hydride materials, safety related issues, Fuel cell – Principle of working, construction and applications.

Bio-Fuels: Concept of Bio-energy: Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials, Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, and Liquefaction. Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc. Bio-fuels: Importance, Production and applications. Bio-fuels: Types of Bio-fuels, Production processes and technologies, Bio fuel applications, Ethanol as a fuel for I.C. engines, Relevance with Indian Economy. Bio-based Chemicals and Materials: Commercial and Industrial Products, Biomass, Feed stocks, Chemicals, Plastics, Fibers etc.

Nuclear Energy: Potential of Nuclear Energy, International Nuclear Energy Policies and Regulations. Nuclear Energy Technologies – Fuel enrichment, Different Types of Nuclear Reactors, Nuclear Waste Disposal, and Nuclear Fusion.

Environmental Biology and Biodiversity: Fundamental concepts of ecology, Ecosystems, Influence of environmental factors (including temperature, light, moisture, soil, nutrients) on organisms and their adaptations in response to them. Global and National Biodiversity Evaluating nature, scale and intensity of the threats to biodiversity. Developing measures for conservation of biodiversity and approaches to its sustainable utilization. Strategy for Conservation of Bio-Resources International conventions and treaties for conservation of bio-resources.

Environmental Chemistry: Chemistry of Water, Physico-chemical methods for analysis of environmental samples - Estimation of various elements at major, minor trace, ultra trace level concentrations: choice of a technique, principle, merits and demerits of the techniques - neutron activation analysis, isotope dilution analysis, colorimetry, atomic absorption spectroscopy, ICPAES, gas chromatography, HPLC, ion exchange chromatography and polarography.

Introduction to Atmospheric and geosciences: Dynamics and structure of the Earth: Structure and composition of Earth. Geochemical cycle, Earth's material; Rocks and minerals. Earthquakes, Volcanoes and Earth's interior. Earth surfaces processes and landforms: Weathering and soils, Mass wasting. Impact of anthropogenic activities such as urbanization, mining, river-valley projects, excess withdrawal of ground water. Atmosphere as a part of biosphere ecosystem, Elements of

weather and climate, Evolution of atmosphere, Atmosphere and environmental issues, Composition and structure of the atmosphere, Need of atmospheric studies in environmental science. Atmospheric hazard: Thunderstorm, Tropical cyclone hurricanes, Global warming, Ozone depletion and droughts.

Environmental Pollution and control: Water Pollution, Water Quality Standards: BIS and WHO for drinking and agricultural water. Determination of various physicochemical parameters of water. Waste water treatment processes: primary, secondary and tertiary.

Air Pollution: Classification of air pollutants, sources, atmospheric reactions, formation of secondary pollutants, permissible limits of air pollutants. Effect of meteorological parameters on transport and diffusion of air pollution, effect of air pollutants on climate. Ozone layer depletion and green house effect. Radiation pollution: Radioactivity and its detection: decay types, various detectors used for measurement of radiations, Management of radioactive wastes: liquid, solid and gases. Noise Pollution: Sources, Measurement, permissible limits, Prevention and control of noise pollution.

GIS and remote sensing: Basics of GIS: Definition and Objectives of GIS, History of GIS, Concept of space and time, Elements of GIS, Map Projection: Conical, Azimuthal and Cylindrical. LCC Projection, UTM and Polyconic projections, EMR spectrum, Radiation laws, Active and Passive remote sensing: Optical, Thermal, Microwave, Resolution in Remote sensing data.

Environmental Impact assessment and Environmental Management: Environmental Impact Assessment: Concept, origin and development of EIA, Historical perspective and definition of EIA and EIS; Need of EIA; Scope, objectives; Negative and positive aspects and uncertainties in EIA, Methodology, Baseline studies, assessment of Impact and management plan, Public Participation, Environmental management system (EMS), Principles and elements, Preparation of Environmental Management Plans (EMS): Environmental management, Overview of ISO 14000 series, Environmental law, rules and regulation.

Watershed Management: Concept of Watershed Management: Definition, Principle, Objectives, Benefits and causes of deterioration, Problem identification Environmental Management: scope, importance, Objectives, Environmental Management tools.

MATERIALS SCIENCE AND NANOTECHNOLOGY (MSN)

Section-I: Bonding in solids; Types of bonds: Metallic, Ionic, Covalent; Vander Waals forces; Hybridization; H- bonding; Ion dipole, and dipole-dipole interactions. Metals, Ceramics and Polymers, Classification, types and general applications, Concepts of Nanoscience and Nanotechnology, Nanomaterials, Spectroscopic Techniques; X-ray Diffraction; Electron Microscopy; Scanning Probe Microscopy; Thermal Analysis Techniques; UV and visible Spectroscopy, Infrared Spectroscopy, NMR Spectroscopy and Raman Spectroscopy.

Section-II: Introduction to MEMs / NEMs, Semiconductor devices, Transistors. Quantum Mechanics; Statistical Mechanics; Statistical distribution functions, Maxwell-Boltzmann Statistics, Molecular energies in an Ideal gas, Rayleigh jeans formula, Plank's Radiation law, Einstein's Approach, specific heat of solids, free electrons in a metal Solid State Physics;

Mechanical Behaviour: Mechanisms, Stress and Strain relations and Analysis, Plasticity Mechanisms, Yielding, Stress and Strain relations and Analysis, Deformation mechanisms, Electronic and optoelectronic devices. Doping and lithography techniques. Degree of polymerization, Glass transition temperature, Conducting polymers, applications of conducting polymers.

Section-III: Bio-molecules–Carbohydrates, Proteins, Lipids; Nucleic acids; RNA and DNA; Hemoglobin and Myoglobin – structure and functions. DNA Biosensors, molecular recognition by cellular communication, Cell structure and transport phenomenon. Recombinant DNA Technology, monoclonal antibodies. Nano-medicine today, DNA computers, hybrid materials, artificial life, tissue engineering. Biocompatible materials and drug delivery systems. Materials for Orthopaedic implants, artificial organs, dental implant; Dermal and facial prosthesis.

Section-IV: Carbon Nanotubes, Functionalization of Carbon Nanotubes, Reactivity of Carbon Nanotubes, Quantum dots and wires. PVD and CVD; reaction chemistry and thermodynamics of CVD; Thermal CVD, laser and plasma enhanced CVD, Chemical Techniques - Spray Pyrolysis, Electrodeposition; Sol-Gel method, Theory and principle of Dip coating, Spin coating and LB Techniques. Electrochemical cells: Primary cell, Secondary cell, Fuel cell and super-capacitors; Corrosion types, monitoring and prevention of corrosion, economics of corrosion.

SAMPLE PAPER PART - A

Note : Part- A shall consist of Fifty (50) MCQs each carrying one mark.

1. Which of the following set of statements best describes the nature and objectives of teaching ? Indicate your answer by selecting from the code.
 - (a) Teaching and learning are integrally related.
 - (b) There is no difference between teaching and training.
 - (c) Concern of all teaching is to ensure some kind of transformation in students.
 - (d) All good teaching is formal in nature.
 - (e) A teacher is a senior person.
 - (f) Teaching is a social act whereas learning is a personal act.

Code :

(A) (a), (b) and (d) (B) (b), (c) and (e) (C) (a), (c) and (f) (D) (d), (e) and (f)

2. Which of the following learner characteristics is highly related to effectiveness of teaching ?
 - A. Prior experience of the learner
 - B. Educational status of the parents of the learner
 - C. Peer groups of the learner
 - D. Family size from which the learner comes.

3. In the two sets given below Set - I indicates methods of teaching while Set - II provides the basic requirements for success/effectiveness. Match the two sets and indicate your answer by choosing from the code :

Set - I

Set - II

(Method of teaching)

(Basic requirements for success/effectiveness)

- | | |
|--|--|
| (a) Lecturing | (i) Small step presentation with feedback provided |
| (b) Discussion in groups | (ii) Production of large number of ideas |
| (c) Brainstorming | (iii) Content delivery in a lucid language |
| (d) Programmed Instructional procedure | (iv) Use of teaching-aids |
| | (v) Theme based interaction among participants |

Code :

- | | | | |
|-----------|-------|-------|-------|
| (a) | (b) | (c) | (d) |
| (A) (i) | (ii) | (iii) | (iv) |
| (B) (ii) | (iii) | (iv) | (v) |
| (C) (iii) | (v) | (ii) | (i) |
| (D) (iv) | (ii) | (i) | (iii) |

4. From the list of evaluation procedures given below identify those which will be called 'formative evaluation'. Indicate your answer by choosing from the code :
- A teacher awards grades to students after having transacted the course work.
 - During interaction with students in the classroom, the teacher provides corrective feedback.
 - The teacher gives marks to students on a unit test.
 - The teacher clarifies the doubts of students in the class itself.
 - The overall performance of a students is reported to parents at every three months interval.
 - The learner's motivation is raised by the teacher through a question-answer session.

Code :

(A) (a), (b) and (c) (B) (b), (c) and (d) (C) (a), (c) and (e) (D) (b), (d) and (f)

5. Assertion (A) : All teaching should aim at ensuring learning.

Reason (R) : All learning results from teaching. Choose the correct answer from the following code :

- A. Both (A) and (R) are true, and (R) is the correct explanation of (A).
- B. Both (A) and (R) are true, but (R) is not the correct explanation of (A).
- C. (A) is true, but (R) is false.
- D. (A) is false, but (R) is true.

6. There are two sets given below. Set - I specifies the types of research, while Set - II indicates their characteristics. Match the two and give your answer by selecting the appropriate code.

Set - I	Set - II
(Research types)	(Characteristics)
(a) Fundamental research	(i) Finding out the extent of perceived impact of an intervention
(b) Applied research	(ii) Developing an effective explanation through theory building
(c) Action research	(iii) Improving an existing situation through use of interventions
(d) Evaluative research	(iv) Exploring the possibility of a theory for use in various situations
	(v) Enriching technological resources

Code :

(a) (b) (c) (d)

(A) (ii) (iv) (iii) (i)

(B) (v) (iv) (iii) (ii)

(C) (i) (ii) (iii) (iv)

(D) (ii) (iii) (iv) (v)

7. Which of the sets of activities best indicate the cyclic nature of action research strategy ?

A. Reflect, Observe, Plan, Act

B. Observe, Act, Reflect, Plan

C. Act, Plan, Observe, Reflect

D. Plan, Act, Observe, Reflect

8. Which of the following sequences of research steps is nearer to scientific method ?

A. Suggested solution of the problem, Deducing the consequences of the solution, Perceiving the problem situation, Location of the difficulty and testing the solutions.

B. Perceiving the problem situation, Locating the actual problem and its definition, Hypothesizing, Deducing the consequences of the suggested solution and Testing the hypothesis in action.

C. Defining a problem, Identifying the causes of the problem, Defining a population, Drawing a sample, Collecting data and Analysing results.

D. Identifying the causal factors, Defining the problem, Developing a hypothesis, Selecting a sample, Collecting data and arriving at generalizations and Conclusions.

9. The problem of 'research ethics' is concerned with which aspect of research activities ?

A. Following the prescribed format of a thesis

B. Data analysis through qualitative or quantitative techniques

C. Defining the population of research

D. Evidence based research reporting

(C) Geo-political considerations (C) Large industries

13. Absence of technology would lead to :

- (a) Less pollution (b) Wastage of precious natural resources
(c) Low value addition (d) Hurting the poorest most

Code :

- (A) (a), (b) and (c) only (B) (b), (c) and (d) only
(C) (a), (b) and (d) only (D) (a), (c) and (d) only

14. The advantage of technological inputs would result in :

- (A) Unbridled technological growth (B) Importing plant machinery
(C) Sidelineing environmental issues (D) Lifting our people to a life of dignity

15. Envisioning a developed India requires :

- A. Aspiration to become a major economic player
B. Dependence upon projects designed abroad
C. Focus on short-term projects
D. Development of core technological strengths

16. Differentiation between acceptance and non-acceptance of certain stimuli in classroom communication is the basis of :

- A. selective expectation of performance
B. selective affiliation to peer groups
C. selective attention
D. selective morality

17. Assertion (A) : The initial messages to students in the classroom by a teacher need not be critical to establish interactions later.

Reason (R) : More control over the communication process means more control over what the students are learning.

Code :

- A. Both (A) and (R) are true, and (R) is the correct explanation of (A).
- B. Both (A) and (R) are true, but (R) is not the correct explanation of (A).
- C. (A) is true, but (R) is false.
- D. (A) is false, but (R) is true.

18. Assertion (A) : To communicate well in the classroom is a natural ability.

Reason (R) : Effective teaching in the classroom demands knowledge of the communication process.

Code :

- A. Both (A) and (R) are true, and (R) is the correct explanation of (A).
- B. Both (A) and (R) are true, but (R) is not the correct explanation of (A).
- C. (A) is true, but (R) is false.
- D. (A) is false, but (R) is true.

19. Assertion (A) : Classroom communication is a transactional process.

Reason (R) : A teacher does not operate under the assumption that students' responses are purposive.

Select the correct code for your answer :

- A. Both (A) and (R) are true, and (R) is the correct explanation of (A).
- B. Both (A) and (R) are true, but (R) is not the correct explanation of (A).
- C. (A) is true, but (R) is false.
- D. (A) is false, but (R) is true.

20. Which of the following set of statements is correct for describing the human communication process ?

(a) Non-verbal communication can stimulate ideas.

(b) Communication is a learnt ability.

(c) Communication is not a universal panacea.

(d) Communication cannot break-down.

(e) More communication means more effective learning by students.

(f) Value of what is learnt through classroom communication is not an issue for students. Code :

(A) (a), (c), (e) and (f)

(B) (b), (d), (e) and (f)

(C) (a), (b), (c) and (d)

(D) (a), (d), (e) and (f)

21. The next term in the series

-1, 5, 15, 29, _____, ...

is :

(A) 36

(B) 47

(C) 59

(D) 63

22. The next term in the series

ABD, DGK, HMS, MTB, SBL, _____, ...

is :

(A) ZKU

(B) ZCA

(C) ZKW

(D) KZU

23. If VARANASI is coded as WCUESGZQ, then the code of KOLKATA will be :

(A) LOQOZEH

(B) HLZEOOQ

(C) ZELHOQO

(D) LQOOFZH

24. Introducing Rakesh to her husband a woman said, "His brother's father is the only son of my grandfather". The woman is related to Rakesh as :

(A) Aunt

(B) Mother

(C) Sister

(D) Daughter

25. Two numbers are in the ratio 2 : 5. If 16 is added to both the numbers, their ratio becomes

1 : 2. The numbers are :

- (A) 16, 40 (B) 20, 50 (C) 28, 70 (D) 32, 80

26. Superiority of intellect depends upon its power of concentration on one theme in the same way as a concave mirror collects all the rays that strike upon it into one point.

What type of reasoning is entailed in the above statement ?

- (A) Mathematical (B) Psychological (C) Analogical (D) Deductive

27. Given below are two premises (A and B). Four conclusions are drawn from them. Select the code that states validly drawn conclusion(s) (taking the premises individually or jointly). Premises :

- (A) Most of the dancers are physically fit.
(B) Most of the singers are dancers.
(a) Most of the singers are physically fit.
(b) Most of the dancers are singers.
(c) Most of the physically fit persons are dancers.
(d) Most of the physically fit persons are singers.

Code :

- (A) (a) and (b) (B) (b) and (c) (C) (c) and (d) (D) (d) and (a)

28. Which one among the following is a presupposition in inductive reasoning ?

- (A) Law of identity (B) Unchangeability in nature
(C) Harmony in nature (D) Uniformity of nature

29. If the proposition 'domestic animals are hardly ferocious' is taken to be false, which of the following proposition/propositions can be claimed to be certainly true ? Select the correct code :

Propositions :

- (a) All domestic animals are ferocious.
(b) Most of the domestic animals are ferocious.
(c) No domestic animal is ferocious.
(d) Some domestic animals are non-ferocious.

Code :

(A) (a) and (b)

(B) (a) only

(C) (c) and (d)

(D) (b) only

30. Which one of the following statements is not correct in the context of Venn diagram method ?

- A. It is a method of testing the validity of arguments.
- B. It represents both the premises of a syllogism in one diagram.
- C. It requires two overlapping circles for the two premises of a standard-form categorical syllogism.
- D. It can be used to represent classes as well as propositions.

The table below embodies data on the production, exports and per capita consumption of rice in country P for the five years from 2012 to 2016. Answer questions 31 - 35 based on the data contained in the table.

Year-wise Production, Exports and Per Capita Consumption of Rice			
Year	Production (in million kg)	Exports (in million kg)	Per Capita Consumption (in kg)
2012	186.5	114	36.25
2013	202	114	35.2
2014	238	130	38.7
2015	221	116	40.5
2016	215	88	42

Where, Per Capita Consumption=(Consumption in million kg)÷(Population in million) and consumption (in million kg)=Production–Exports.

31. The percentage increase in the consumption of rice over the previous year was the highest in which year ?

- (A) 2013 (B) 2014 (C) 2015 (D) 2016

32. What is the population of the country in the year 2014 (in million) ?

- (A) 2.64 (B) 2.72 (C) 2.79 (D) 2.85

33. The ratio of exports to consumption in the given period was the highest in the year :

- (A) 2012 (B) 2013 (C) 2014 (D) 2015

34. In which year, the population of country was the highest ?

- (A) 2013 (B) 2014 (C) 2015 (D) 2016

35. What is the average consumption of rice (in million kg) over the years 2012-2016 ?

- (A) 104 (B) 102.1 (C) 108 (D) 100.1

36. Which of the following statements, regarding the term ICT is/are TRUE ? P : ICT is an acronym that stands for Indian Classical Technology.

Q : Converging technologies that exemplify ICT include the merging of audio-visual, telephone and computer networks through a common cabling system.

- (A) P only (B) Q only (C) P and Q (D) Neither P nor Q

37. A new Laptop has been produced that weighs less, is smaller and uses less power than previous Laptop models.

- (A) Universal Serial Bus Mouse (B) Faster Random Access Memory
(C) Blu Ray Drive (D) Solid State Hard Drive

38. Given the following email fields, which of the email addresses will 'swami' be able to see when he receives the message ?

To...	ram@test.com
-------	--------------

Cc...	raj@test.com; ravi@test.com
Bcc...	swami@test.com; rama@test.com

- A. ram@test.com
- B. ram@test.com; raj@test.com; ravi@test.com
- C. ram@test.com; rama@test.com
- D. ram@test.com; rama@test.com; raj@test.com; ravi@test.com

39. Put the following units of storage into the correct order, starting with the smallest unit first and going down to the largest unit :

- (a) Kilobyte (b) Byte (c) Megabyte
- (d) Terabyte (e) Gigabyte (f) Bit

Give your answer from the following code :

- (A) (f), (b), (a), (c), (d), (e) (B) (f), (b), (a), (d), (e), (c)
- (C) (f), (b), (a), (c), (e), (d) (D) (f), (b), (a), (d), (c), (e)

40. With regard to computer memory, which of the following statement(s) is/are TRUE ? P : Read Only Memory (ROM) is 'volatile' memory.

Q : Random Access Memory (RAM) is 'volatile' memory.

- (A) P only (B) Q only (C) P and Q only (D) P and R only

41. 'Fly ash' produced in thermal power plants is an ecofriendly resource for use in :
- (a) agriculture as micro-nutrient
 - (b) wasteland development
 - (c) dam and water holding structures
 - (d) brick industry
- (A) (a), (b) and (d) only (B) (b), (c) and (d) only
(C) (a), (c) and (d) only (D) (a), (b), (c) and (d)
42. Which of the following types of natural disasters has no definite beginning and end ?
- (A) Earthquakes (B) Landslides (C) Hurricanes (D) Droughts
43. Assertion (A) : Indoor air pollution is a serious health hazard.
Reason (R) : The dispersal of air pollutants is rather limited in indoor environment. Choose the correct answer from the code given below :
- A. Both (A) and (R) are true and (R) is the correct explanation of (A).
 - B. Both (A) and (R) are true but (R) is not the correct explanation of (A).
 - C. (A) is true and (R) is false.
 - D. Both (A) and (R) are false.
44. In terms of their contribution to the total power generation in India, identify the correct sequence of energy sources - Thermal Power Plants (TPP), Large Hydropower Projects (LHP), Nuclear Energy (NE) and Renewable Energy (RE) which includes solar energy, wind energy, biomass and small hydropower projects.
- (A) TPP > RE > LHP > NE (B) TPP > LHP > RE > NE
(C) LHP > TPP > RE > NE (D) LHP > TPP > NE > RE
45. Which of the following is considered as major source of pollution in rivers of India ?
- (A) Unregulated small scale industry (B) Untreated sewage
 - (C) Agricultural run-off (D) Thermal power plants

46. India has the largest Higher Education System in the World after :

- (a) The United States of America
- (b) Australia
- (c) China
- (d) United Kingdom (U.K.)

Select the correct answer from the code given below :

- (A) (a), (b), (c) and (d)
- (B) (a), (b) and (c) only
- (C) (a), (c) and (d) only
- (D) (a) and (c) only

47. Prime Minister Research Fellowship is for students pursuing Ph.D programme in :

- A. State and Central Universities
- B. Central Universities, IISc, IITs, NITs, IISERs and IIITs
- C. IISc, IITs, NITs, IISERs, IIITs, State and Central Universities
- D. IITs and IISc

48. Leader of the Opposition is a member of committees which select :

- (a) the Central Information Commissioner
- (b) the Central Vigilance Commissioner
- (c) the Chairperson of National Human Rights Commission
- (d) the Chairperson of National Commission for Women

- (A) (a), (b), (c) and (d)
- (B) (a), (b) and (c) only
- (C) (a), (c) and (d) only
- (D) (a), (b) and (d) only

49. Which of the following statements are correct about gender budgeting ?

- (a) It is a separate budget addressing the specific needs of women.
- (b) It assesses the impact of government budget on women.
- (c) It is an accounting exercise.

(d) It is another budgeting innovation.

(A) (b) and (d) only

(B) (a) and (d) only

(C) (a), (c) and (d) only

(D) (b), (c) and (d) only

50. Which of the following are the barriers to citizen-centric administration in India ?

(a) Wooden and inflexible attitude of the civil servants

(b) Ineffective implementation of laws and rules

(c) Awareness of rights and duties of citizens

(d) Lack of job opportunities for the youth

(A) (a), (b), (c) and (d)

(B) (a), (b) and (c) only

(C) (a), (b) and (d) only

(D) (a) and (b) only

Amendment – I (05/11/2018)

Due to University Grants Commission (Minimum Standards and Procedure for Award of M. Phil / Ph. D Degrees) (2nd amendment) Regulations, 2018, the Clause 3.11 of Ph. D Prospectus 2018-19 (Even Semester) is notified accordingly. The amended Clause is given below:

3.11 The DRC after due assessment of the candidate's competence for the proposed research, area of research and its contribution to knowledge and also taking due note of vacancy available in the research area will prepare a merit list.

While preparing the merit list, weightages shall be given according to the following criteria:-

- vi. 30% for the marks in the seminar/presentation/interview to be conducted by the respective DRCs/ CRCs.
- ii. 70% for the marks in the Entrance Test.

OR

50 marks to those candidates who have qualified valid **JRF** (UGC / CSIR / DBT / any other through an Entrance Test).

OR

35 marks to those candidates who have qualified valid GATE / NET.

However, candidate covered under the exempted categories may also appear in the entrance test, if they so desire, to improve their weightage.

Note: The merit of the candidates who are availing weightage of valid **JRF** (UGC / CSIR / DBT / any other through an Entrance Test) / GATE / NET will be considered in the category in which they were issued certificate by UGC / other equivalent agencies or in their own category.

Number of vacant slots may be decreased depending on the suitability of applicants.