

# I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Estd. Under Punjab Technical University Act, 1996  
(Punjab Act No. 1 of 1997)

Ref. No. : IKGPTU/Reg/N/ 706

Dated : 11.10.17

## NOTIFICATION

Sub: **Standard operating procedure (SOP) for written test regarding recruitment of Technical Assistants for University Campuses.**

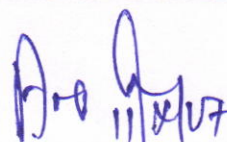
Vice Chancellor approved on 04/10/2017, the following Standard operating procedure (SOP) for written test regarding recruitment of Technical Assistants for I.K. Gujral Punjab Technical University Campuses.

### 1. Purposes and Scope:

I.K. Gujral Punjab Technical University has established 14 teaching departments under 7 faculties at its main campus in academic session 2016-17 vide notification IKGPTU/REG/N/3524, dated 14/12/2016. Based on the requirements raised by the departments to cater the needs of various laboratories; recruitment of Technical Assistants was assessed & process started vide advertisement no. 506 (**Annexure-A**) and corrigendum (**Annexure-B**). The distribution of posts in various departments of main campus & other constituent campuses with required qualifications and experience is placed at **Annexure-C**. As per Notification IKGPTU/REG/N/4510, dated: 24/11/2016 (**Annexure-D**), the selection procedure is as under:

- i) The selection for technical staff in each subject shall be based on a written test comprising 100 marks:
  - a) Section- A (Theory) - 80 Marks
  - b) Section- B (Practical knowledge) - 20 Marks

The written test will consist of two sections. Section- A will consist of 80 objective type multiple choice questions with one mark each for assessing theoretical knowledge. Section-B will consist of 20 objective type multiple choice questions with one mark each for assessing practical/experiments knowledge in the qualifying examination.



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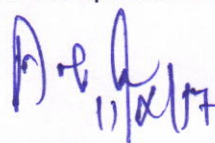
- ii) To qualify in the theory and practical test, the candidate will have to secure at least 50% marks separately that is 40 marks out of 80 in theory and 10 out of 20 marks in practical knowledge based written test.
- iii) After the conduct of written test, the answer key will be uploaded on the website within 24 hours for inviting objections to answers, if any. The objection to any answer can be filled by the candidate on the prescribed objection form available on the website within 3 days from the conduct of written test. The candidate has to provide the relevant documentary proof in the form of book, relevant article etc. in support of his/her objection, otherwise the objection will not be entertained. Suggestions/objections to be submitted O/o Vice Chancellor by addressing such objections to Vice Chancellor only.
- iv) In case of two or more candidates obtained equal marks in the sections A and B, the merit will be decided in order of following:
  - a) Candidate with higher qualification shall be placed higher in merit.
  - b) If still there is a tie between candidates, elder in age will be placed higher in merit.
  - c) If the tie still persists between candidates, the candidates obtaining higher percentage of marks in qualifying academic qualification shall be placed higher in merit.
- v) The conduct of the written test and preparation of merit list shall be managed through a committee with following constitution:
  - a) Dean to be nominated by Vice Chancellor
  - b) Registrar
  - c) Two Professors/Associate Professors from IKGPTU main campus/other campuses.

**The present SOP has been drafted to define the steps & procedure to be followed for conducting written test for recruiting Technical Assistants so that the subject knowledge of applicants may be checked & best of them may be recruited.**

## **2. Conduct of Written Test:**

### **2.1 Syllabus**

For engineering streams, the syllabus from Department of Technical Education and Industrial Training shall be downloaded. For sciences, syllabus as per UGC model curriculum shall be applicable. The syllabus shall be vetted by the HOD of concerned stream along with department faculty & if required necessary changes may be done. Final approved syllabus will be sent to Department of ITS of IKGPTU through Recruitment Cell to be uploaded on website.



## **2.2 Pattern of question papers**

Question papers shall consist of 100 multiple choice (four alternatives) objective type questions carrying one mark each. The candidate is to select one specific answer and mark it on the answer sheet (OMR) with only dark black ball pen / Gel pen as per the instructions contained in the Question Paper Booklet / OMR sheet.

## **2.3 Setting, selection and printing of question papers**

Two sets of question papers shall be prepared by two independent paper setters of each stream. It shall be ensured that each question shall have a single specific answer. The final question paper shall be selected from these sets. A single agency shall be hired to print the papers.

### **2.3.1 Jumbling of questions**

Four sets A, B, C and D shall be prepared by suitably jumbling the questions.

The jumbling key as generated from the press shall be manually checked and approved by the Written Test Committee after the examination before it is used for evaluation.

### **2.3.2 Issuance of admit cards**

Admit cards shall be issued by examination department exactly 7 days before the date of written test.

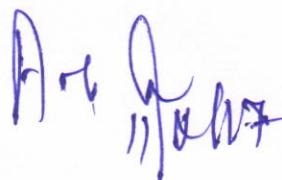
### **2.3.3 Uploading of answer key**

After the conduct of written test, the answer key will be uploaded on the website within 24 hours for inviting objections to answers, if any. The objection to any answer can be filled by the candidate on the prescribed objection form available on the website within 3 days from the conduct of written test. The candidate has to provide the relevant documentary proof in the form of book, relevant article etc. in support of his/her objection, otherwise the objection will not be entertained. Suggestions/ objections to be submitted O/O Vice Chancellor by addressing such objections to Vice Chancellor only.

## **3. Evaluation and Declaration of Results:**

### **3.1 Scanning and result preparation**

A single agency shall be hired for the preparation of OMR, scanning and preparation of the results. However, the result so prepared shall be counter checked by engaging another independent agency /(or) at the university computer centre.



### **3.2 Verification of results**

The results thus prepared above shall be verified and approved by the committee before declaration of results. The committee shall manually verify at least 5% of the OMR sheets and certify the correctness of the evaluation.

### **3.3 Declaration of results**

- a) Final merit list shall be approved by the Vice Chancellor.
- b) Committee shall hand over the approved list and other relevant records of the conduct of selection process to recruitment section/HR section for issuance of appointment letters as per University norms.
- c) List of selected candidates shall be available on the University website [www.ptu.ac.in](http://www.ptu.ac.in) within 7 days from the date of conduct of test and no separate result cards will be sent.

## **4. Identification and Emphasis of Critical Steps:**

The following critical steps are identified and the step-by-step procedure to deal with the critical steps is detailed.

### **4.1 Setting of question papers**

- Two independent sets of question papers.
- Coverage of entire syllabi.
- Moderation and checking the correctness of answers by independent team of experts.

### **4.2 Preparation and verification of results**

- Single agency for printing of OMR, scanning and preparation of results.
- Manual verification of results prepared for at least 5% of sample cases by the committee.

### **4.3 Transparency**

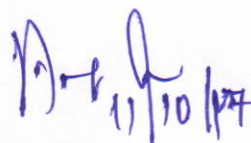
- Uploading of answer keys after the written test.
- Availability of roll numbers and results on website.

## **5. Records to be Kept**

The OMR sheets and the attendance sheet of the students shall be preserved for period of 6 months from the date of declaration of results.

## **6. Who is Responsible**

The activities of Technical Assistant Written Test-2017 shall be coordinated by the committee appointed vide office order IKGPTU/DR/HRD/844, Dated 12/6/2017.

  
11/10/17

## 7. Authority


Any issue not covered here in shall be dealt with as per provisions of the information on IKG PTU web-site and notwithstanding any thing contained in this document Vice Chancellor, IKGPTU shall be the competent authority to decide on any issue pertaining to written test and the decisions shall be final and binding.

  
Registrar

Endst. No. IKGPTU/Reg/N/707-711

Dated: 11.10.17

1. OSD to VC: For kind information of Vice- Chancellor
2. All HOD's (Teaching & Non-Teaching)
3. DR (ITS): For uploading on official website of IKGPTU
4. DR (HRD)
5. File copy

  
Registrar



I.K. GUJRAL

# PUNJAB TECHNICAL UNIVERSITY

JALANDHAR-KAPURTHALA HIGHWAY, KAPURTHALA Website : [www.ptu.ac.in](http://www.ptu.ac.in)

## Advt. No. 506

Online applications are invited for the following posts on regular basis :

Name of Post	Pay Scale	Number of Post (s)
Associate Professor (Architecture)	37400-67000 (AGP-9000)	02
*Assistant Professor (Architecture)	15600-39100 (AGP-6000)	05
Assistant Librarian (Grade-1)	15600-39100 (AGP-6000)	01
Assistant Librarian (Grade-2)	10300-34800 (GP-3800)	02
Technical Assistant	10300-34800 (GP-3800)	32

\*Note : The candidate(s) will be appointed for these positions with a rider that any such entrant shall be eligible for next promotion only after acquiring the Ph.D. Degree.

Eligibility : Detail of Eligibility criteria are available on University website [www.ptu.ac.in](http://www.ptu.ac.in).

Application Fee : Application fee is Rs. 500/- for General Candidates and Rs. 250/- for SC/ST candidates.

Reservation Policy : As per the Punjab State Govt. norms.

Applicants for the post of Technical Assistant shall exercise the choice of campuses in the application form itself.

For further details visit university website [www.ptu.ac.in](http://www.ptu.ac.in).

Last date for Submission of online Application : 08<sup>th</sup> June, 2017.

Last date for Submission of Hard Copy of Application : 15<sup>th</sup> June, 2017.



I.K. Gujral

www.ptu.ac.in

# Punjab Technical University

(A State Govt. University)

Jalandhar

Jalandhar - Kapurthala Highway, Kapurthala

## CORRIGENDUM

Reference is made to our Advertisement No. 506 appeared in this newspaper on 25-05-2017.

Please note that the Campus wise, Branch wise and Category wise details with essential qualification / experience for the post of Technical Assistant is updated on university website. The last date for filling up of online application for the post of Technical Assistant only has been extended to 18-06-2017 and the last date of submission of hard copy of application form is extended to 26-06-2017. The candidates who have applied earlier are advised to visit university website for fresh guidelines.

Advt no. 506/01

Registrar

Sr.no.	Location	No. of Posts	Stream	Qualification & Experience
1	IKGPTU, Hoshiarpur Campus	1	Computer Science and Engineering	1 <sup>st</sup> Class Diploma in relevant branch from recognised University/State Board of Technical Education with minimum two years Experience in relevant field. Desirable : B.Tech in Relevant Branch Or MCA (for Computer Science only)
2		1	Civil Engineering	
3		1	Mechanical Engineering	
4	IKGPTU, Bhikhiwind Campus	1	Computer Science and Engineering	
5		1	Mechanical Engineering	
6	IKGPTU, Batala Campus	1	Electrical Engineering	
7		1	Computer Science and Engineering	
8	IKGPTU, Main Campus, Kapurthala	3	Workshop	
9		3	Mechanical Engineering	
10		3	Civil Engineering	
11		3	Electrical Engineering	
12		3	Electronics and Communication Engineering	
13		3	Computer Science and Engineering	
14		2	Food Sciences & Technology	
15	2	Physics	1 <sup>st</sup> Class B.Sc. (Non Medical) with minimum two years experience in relevant field Desirable : M.Sc. in relevant subject	
16	2	Chemistry		
17	1	Math		
Total :		32 (SC-07, Gen-16, Ex-Ser - 03, BC- 03, PH - 01, Ex-Ser (SC) - 01, Sportsman - 01)		

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7/6/17

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7/6/17



# I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Estd. Under Punjab Technical University Act, 1996  
(Punjab Act No. 1 of 1997)

Ref. No. : IKGPTU/Reg/N/4510

Dated : 24.11.16

## NOTIFICATION

Vice Chancellor, IKGPTU has approved the enclosed procedure for the recruitment of Technical and Library Staff in I. K. Gujral Punjab Technical University, Jalandhar (copy enclosed).

-Sd-  
Registrar

Endorsement No.: 4511-4515

Dated: 24.11.16

### Copy to:

1. Secretary to Vice Chancellor: For kind information to Vice Chancellor.
2. All HODs, IKGPTU
3. DR (HRD)
4. DR (Computer Cell): For upload on official website.
5. Office Copy / file copy

Registrar  
24/11/16

I. K. Gujral Punjab Technical University, Jalandhar  
Jalandhar Kapurthala Highway, Near Pushpa Gujral Science City, Kapurthala - 144 603  
Ph. No. 01822 - 662521, 662501 Fax No. : 01822-255506, 662526, Email : registrar@ptu.ac.in

# I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Procedure for the recruitment of Technical and Library Staff in I.K. Gujral Punjab Technical University (Referring Punjab Govt. Notification No. 12/152/2015-5 PP.2/720133/1 dated 28/03/2016)

The selection of Technical Staff and Library Staff in the University shall be made as per procedure and guidelines in reference to notification vide letter No. 12/152/2015-5 PP.2/720133/1 dated 28.03.2016 issued by Punjab Government and with approval of Board of Governors, IKGPTU from time to time.

## A. INVITING APPLICATIONS FOR THE POSTS :

The applications for the posts of Technical and Library Staff as mentioned in Annexure-'A' as approved by the Board of Governors, IKGPTU shall be invited through open advertisement in the prescribed format through leading newspapers. The same shall be posted on the University Website [www.ptu.ac.in](http://www.ptu.ac.in) along with detailed eligibility criteria in accordance with the procedure and guidelines as prescribed by the Board of Governors, IKGPTU, from time to time.

## B. ELIGIBILITY CRITERIA :

The minimum eligibility for the post of Technical Staff in Engineering and Technology, Applied Sciences, Pharmacy, Workshop and Librarian etc shall be as per DTE, Punjab Government and Board of Governors, IKGPTU as amended from time to time (Copy enclosed **Annexure B**):

## C. SELECTION OF CANDIDATES :

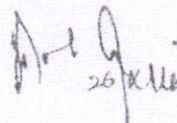
(1) Selection for technical staff in each subject shall be based on a written test comprising 100 marks:

(i) Section-A (Theory)	-	80 Marks
(ii) Section-B (Practical knowledge)	-	20 marks

The written paper will consist of two sections. Section-A will consist of 80 objective type multiple choice questions with one mark each for assessing theoretical knowledge. Section-B will consist of 20 objective type multiple choice questions with one mark each from assessing practical/experiments knowledge in the qualifying examination. There shall be no negative marking. Candidate will mark their answer on OMR sheet.

(2) To qualify in the theory and practical test, the candidate will have to secure at least 50% marks separately i.e. 40 marks out of 80 in theory and 10 out of 20 marks in practical knowledge based written test.

(3) After the conduct of written test, the answer key will be uploaded on the website for inviting objections to answers, if any. The objection to any answer can be filled by the candidate on the prescribed objection form available on the website within three days from the conduct of the written test. The candidate has to provide relevant documentary proof in the form of book, relevant article etc in support of his/her objection, otherwise the objection will not be entertained.

  
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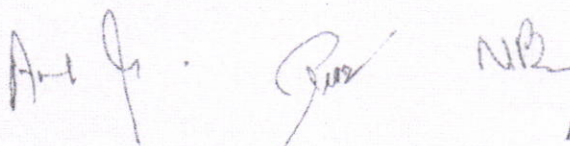
Suggestion/objections to be submitted O/O Vice Chancellor by addressing such objection to Vice Chancellor only.

- (4) In case two or more candidates obtaining equal marks in the Section-A and B, the merit will be decided in order of following:
  - (i) Candidate with higher qualification shall be placed higher in merit.
  - (ii) If still there is a tie between candidates, elder in age will be placed higher in merit.
  - (iii) If the tie still persists between candidates, the candidates obtaining higher percentage of marks in qualifying academic qualification shall be placed higher in merit.
- (5) The conduct of the written test and preparation of merit list shall be managed through a committee with following constitution:
  - i. Dean to be nominated by Vice Chancellor
  - ii. Registrar
  - iii. Two Professors/Associate Professor from IKGPTU main campus /other campuses

#### D. SELECTION PROCEDURE

- (1) Recruitment section /HR section of University Shall be responsible for drafting of advertisement, inviting applications from eligible candidates, scrutiny of applications as per eligibility condition and submission of all relevant records along with subject wise list of eligible candidates to the committee constituted at C(5).
- (2) (a) Vice chancellor shall nominate one member from the committee as mentioned in C(5) for confidential work. The nominated member may co-opt any one or two members from within the committee or University for assistance in confidential work.  
(b) Committee shall be responsible for the preparation of results and merit after the conduct of the written test.  
(c) Final merit list shall be approved by the Vice Chancellor and shall be the appointing authority.  
(d) Committee shall hand over the approved list and other relevant records of the conduct of the selection process to recruitment section/HR section for issuance of appointment letters as per University norms.
- (3) List of selected candidates shall be put up on the University website [www.ptu.ac.in](http://www.ptu.ac.in).
- (4) The University shall not hold any responsibility for non-receipt of intimation on account of change in the correspondence address or wrong email ids.

#### E. RESERVATION POLICY:



Reservation shall as per State Government Reservation Policy and Backlog, if any, shall be filled accordingly.

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## I.K.Gujral Punajb Technical University, Jalandhar

**Subject: Syllabus for Written Test of Technical Assistant for Electronics and Communication Engineering Stream.  
(against advertisement no:506)**

**ELECTRONIC INSTRUMENTS AND MEASUREMENT:** Basics of Measurements, Voltage, Current and Resistance Measurement, Cathode Ray Oscilloscope, Signal Generators and Analytical Instruments, Impedance Bridges and Q Meters, Digital Instruments.

**PRINCIPLES OF COMMUNICATION ENGINEERING:** Need for modulation, Amplitude modulation, Frequency modulation, Phase modulation, Principles of modulators, Principles of FM Modulators, Demodulation of AM Waves, Demodulation of FM Waves, Pulse Modulation.

**DIGITAL ELECTRONICS:** Distinction between analog and digital signal, Applications and advantages of digital signals, Number System, Codes and Parity, Logic Gates and Families, Logic Simplification, Arithmetic circuits, Decoders, Multiplexers and De Multiplexers, Latches and flip flops, Counters, Shift Register, A/D and D/A Converters.

**ELECTRONIC DEVICES AND CIRCUITS:** Multistage Amplifiers, Large Signal Amplifier, Feedback in Amplifiers, Sinusoidal Oscillators, Tuned Voltage Amplifiers, Wave Shaping Circuits, Multivibrator Circuits, Operational Amplifiers, Regulated DC Power Supplies, Opto Electric Devices.

**ELECTRICAL MACHINES:** Three Phase Supply, Transformers, Introduction to Rotating Electrical Machines, DC Machines, A.C. Motors, Single Phase Fractional Kilowatt Motors.

**COMPUTER PROGRAMMING AND APPLICATIONS:** Algorithm and Program Development, Program Structure (C Programming), Functions, Arrays, Pointers, Strings, Data files, Software Applications in Electronics Engineering.

**NETWORK FILTERS AND TRANSMISSION LINES:** Networks, Attenuators, Filters, Transmission Lines.

**COMMUNICATION SYSTEMS-1:** AM/FM Transmitters, AM/FM Radio Receivers, Antennas, Propagation, Fibre Optic Communications, Satellite Communications.

**POWER ELECTRONICS:** Introduction to thyristors and other Power Electronics Devices, Controlled Rectifiers, Inverters, Choppers, Dual Converters and Cyclo converters, Thyristorised Control of Electric drives, Uninterrupted Power supplies.

**CONSUMER ELECTRONICS:** Audio Systems, Television, LCD and LED Television: Basic principle and working of LCD & LED TV, Cable Television: Working of Cable TV, DTH, and Consumer Appliances.

**PERSONAL COMPUTER ORGANIZATION (PCO):** Mother Board, Buses and Ports, Memory, Keyboard and Mouse, CRT Display Devices, Printers.

**COMMUNICATION SYSTEMS – II:** Introduction, Coding, Digital Modulation Techniques, Characteristics/working of data transmission circuits, UART, USART, Modems, Telemetry, Electronic Exchange.

**MICROWAVE AND RADAR ENGINEERING:** Introduction to Microwaves, Microwave Devices, Wave guides, Microwave Components, Microwave antennas, Microwave Communication systems, Radar Systems, Introduction to VSAT transponders multiple access techniques, VSAT and its features.

**WIRELESS AND MOBILE COMMUNICATION:** Wireless Communication, Cellular Concept, Multiple Access Techniques for Wireless Communication, Mobile Communication Systems.

# I.K.Gujral Punajb Technical University, Jalandhar

**Subject: Syllabus for Written Test of Technical Assistant for Electrical Engineering Stream (against advertisement no: 506).**

**FUNDAMENTALS OF ELECTRICAL ENGINEERING:** Application and Advantages of Electrical Energy, DC Circuits, Batteries, Magnetism and Electromagnetism, Electromagnetic Induction, AC Fundamentals, AC Circuits, Poly-Phase systems.

**ELECTRONICS:** Brief history of development of electronics, Semi-conductor Theory, Semiconductor Diodes, Bi-polar Transistors, Transistor Biasing and Stabilization, Single-Stage Transistor Amplifiers, Multi-Stage Transistor Amplifiers, Field Effect Transistor (FET), Transistor Audio Power Amplifier, Tuned Voltage Amplifier, Feedback in Amplifiers, Sinusoidal Oscillators, Wave-Shaping and Switching Circuits, Power supplies, Operational Amplifier.

**ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS:** Classification, Conducting Materials, Review of Semi-conducting Materials, Insulating materials, General Properties, Insulating Materials and their applications, Magnetic Materials, Special Materials, Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc.

**ELECTRICAL ENGINEERING DESIGN AND DRAWING:** Symbols and Signs Conventions, Panels/Distribution Boards, Orthographic Projections of Simple Electrical Parts, Orthographic Projection of Machine Parts, Contactor Control Circuits.

**ELECTRICAL MACHINES:** Introduction to Electrical Machines, DC Machines, Transformers (single phase), Transformers Three Phase, Synchronous Machines, Induction Motors, Fractional Kilo Watt (FKW) Motors, Special Purpose Machines.

**ELECTRICAL MEASURING INSTRUMENTS AND INSTRUMENTATION:** Introduction to Electrical Measuring Instruments, Ammeters and Voltmeters (Moving coil and moving iron type), Wattmeters (Dynamometer Type), Energymeter (Induction type), Miscellaneous Measuring Instruments, Electronic Instruments, LCR meters, Power measurements in 3-phase circuits.

**ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING:** Purpose of estimating and costing, Types of wiring, Estimating and Costing, Estimating the material required for Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations, Substation.

**ELECTRICAL POWER:** Power Generation, Economics of Generation, Transmission Systems, Distribution System, Substations, Power Factor, Faults, Switch Gears, Protection Devices, Protection Scheme, Over-voltage Protection, Various Types of Tariffs.

**INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES:** SCR, Controlled Rectifiers, Inverters, Choppers, Dual Converters and Cyclo Convertors, Thyristor Control of Electric Drives, Uninterrupted power supplies.

**INSTRUMENTATION:** Measurements, Transducers, Force and Torque Measurement, Pressure Measurement, Flow Measurement, Measurement of Temperature, Measurement of other non electrical quantities.

**DIGITAL ELECTRONICS AND MICROPROCESSORS:** Number Systems, Gates, Boolean Algebra, Combinational Circuits, Flip-Flops, Introduction of Shift Registers and Counters, A/D and D/A Converters , Semi-conductor Memories, Microprocessor of 8085.

**UTILIZATION OF ELECTRICAL ENERGY:** Illumination, Electric Heating, Electric Welding, Electrolytic Processes, Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers, Electric Drives, Electric Traction.

**MODERN ELECTRIC TRACTION:** Electric Traction System, System of Track Electrification, Track Mechanics, Power Supply arrangement, Equipment used in and outside the Locomotive, Traction Motors and Traction Motor Control, Braking, Train Lighting, Railway Coach Air-conditioning.



## **I.K.Gujral Punajb Technical University, Jalandhar**

**Subject: Syllabus for Written Test of Technical Assistant for Computer Science and Engineering Stream (against advertisement no:506).**

**COMPUTER PROGRAMMING USING 'C':** Algorithm and Programming Development, Program Structure, Control Structures, Functions, Arrays, Pointers, Structures and Unions, Strings, Files.

**RELATIONAL DATABASE MANAGEMENT SYSTEM (RDBMS):** Introduction, Database Systems, Database System Concepts and Architecture, Data Modeling using E.R. Model (Entity Relationship Model), Relational Model: Relational Model Concepts, Normalization, Database Access and Security, MYSQL/SQL (Structured Query Language)SQL\* Plus, DDL (Data Definition Languages, PL/SQL).

**MULTIMEDIA AND APPLICATIONS:** Introduction, Multimedia Hardware, Multimedia Software, Using Image Processing Tools, Multimedia Authoring Tools.

**DATA STRUCTURES USING 'C':** Fundamental Notation, Arrays, Linked Lists, Stacks, Queues and Recursion, Trees, Sorting and Searching.

**OBJECT ORIENTED PROGRAMMING USING C++:** Introduction and Features, Language Constructs, Classes and Objects, Member Functions, Overloading Member Functions, Inheritance, Polymorphism and Virtual Functions, File and Streams, Introduction to Standard Template Library(STL).

**COMPUTER ARCHITECTURE:** Data Representation, Data Types-Number System, 1's Complement, 2's Complement, BCD Code, Gray Code, Central Processing Unit, Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Introduction to RISC, CISC architecture, Pipeline processing, Arithmetic Operations, Introduction, Addition, Subtraction, Multiplication and Division algorithm, Input-Output Organization, Memory Organisation.

**INTERNET AND WEB TECHNOLOGIES:** Internet Basics, Internet Connectivity, World Wide Web (WWW), Internet Security, Developing Portals Using HTML, Server-side Scripting, Dream weaver.

**COMPUTER PERIPHERALS AND INTERFACING:** Video Display, Hardware Organization of PCs, Storage Devices, Input Devices, Output Devices, Power Supplies, Basic Input/ Output System, Other Technologies.

**OPERATING SYSTEMS:** Overview of Operating Systems, Functions of Operating System, Linux Operating System.

**COMPUTER NETWORKS:** Networks Basics, OSI Model, Introduction to TCP/IP, Protocol Suites, Network Architecture, Network, Connectivity, Network Administration / Security, Network Trouble Shooting Techniques, Wireless Networking.

**OPEN SOURCE TECHNOLOGIES:** Introduction, Practice with Linux Commands, Shell Programming, Communication Commands (utilities), Introduction to C/C++ Programming in Linux environment, Introduction to Apache Server with PHP and My SQL.

**NETWORK SECURITY:** Introduction, Securing Data over Internet, Virus, Worms and Trojans, Computer Network Attacks, Firewalls, Intrusion Detection System (IDS), Virtual Private Network (VPN) Disaster and Recovery, OS Vulnerabilities.

**INSTALLATION, MAINTENANCE AND TROUBLE SHOOTING OF COMPUTER NETWORKS:** Installation, Repair, Servicing and Maintenance Concepts, Fundamental Trouble Shooting Procedures, Networking, Trouble shooting of computers, component and peripherals, Sharing of devices on Networks, Installation and management of network sharing tools, Establishment of LAN/WAN.

## I.K.Gujral Punajb Technical University, Jalandhar

**Subject:** Syllabus for Written Test of Technical Assistant for Civil Engineering Stream (against advertisement no: 506).

**FLUID MECHANICS:** Properties of Fluids, Pressure, Measurement of Pressure, Fundamentals of Fluid Flow, Flow Measurements Flow through Pipes, Flow through open channels, Hydraulic Pumps.

**APPLIED MECHANICS:** Laws of forces, Moment, Friction, Centre of Gravity, Simple Machines.

**SURVEYING:** Basic principles of surveying, Chain surveying, Compass surveying, Levelling, Plane Table Surveying, Concept of Two point and Three point problems, Contouring, Theodolite Surveying, Tacho-metric surveying, Curves, Introduction to the use of Modern Surveying equipment and techniques.

**CONSTRUCTION MATERIALS:** Building Stones, Bricks and Tiles, Cement, Lime, Timber and Wood Based Products, Paints and Varnishes, Ferrous metals, Miscellaneous Materials.

**BUILDING CONSTRUCTION:** Building, Foundations, Walls, Masonry, Arches and Lintels, Doors, Windows and Ventilators, Damp Proofing and Water Proofing, Floors, Roofs, Glossary of terms, Surface Finishes, Anti Termite Measures, Building Planning, Building Services.

**CONCRETE TECHNOLOGY :** Definition of concrete, Ingredients of Concrete, Water Cement Ratio, Workability, Properties of Concrete, Proportioning for Normal Concrete, Introduction to Admixtures, Special Concretes Concreting Operations, Transportation of concrete, Importance and methods of non-destructive tests.

**IRRIGATION ENGINEERING:** Irrigation, Water Requirement of Crops, Hydrological Cycle, Methods of Irrigation, Canals, Tube Well Irrigation, **Dams**, Canal Head Works and Regulatory Works, Cross Drainage Works, River Training Works, Water Logging and Drainage and Ground Water Re-charge.

**STRUCTURAL MECHANICS :** Properties of Materials, Simple Stresses and Strains, Shear Force and Bending Moment, Moment of Inertia, Bending Stresses in Beams, Combined Direct and Bending Stresses, Shear Stresses in Beams, Slope and Deflection, Columns, Analysis of Trusses.

**REINFORCED CONCRETE DESIGN:** Concept of Reinforced Cement Concrete (RCC), RCC design, Shear, and Development Length, Singly Reinforced Beam, Concept of Limit State Method, Singly Reinforced beam, One and Two Way Slab, Axially Loaded Column, Prestressed Concrete.

**HIGHWAY ENGINEERING, RAILWAYS, BRIDGES AND TUNNELS:** Importance of Highway engineering, Road Geometrics: Highway Surveys and Plan, Road Materials, Road Pavements, Hill Roads, Road Drainage, Road Maintenance, Road Construction Equipment, Railway surveys, Bridge, Classification of Bridges, Bridge Foundations, Maintenance of Bridges, Tunnels, Ventilation, Drainage method of draining water in tunnels, Lighting of tunnels.

**SOIL AND FOUNDATION ENGINEERING:** Importance of soil studies, Physical Properties of Soils, Classification and Identification of Soils, Flow of Water Through Soils, Effective Stress, Deformation of Soils, Shear Strength Characteristics of Soils, Compaction, Soil Exploration, Bearing Capacity of soil, Foundation Engineering.

**STEEL STRUCTURES DESIGN:** Structural Steel and Sections, Riveted Connections, Welded connections, Tension Members, Compression Members, Roof Trusses, Columns, Beams, Fabrication and Erection of Steel Structures.

**EARTHQUAKE RESISTANT BUILDING CONSTRUCTION:** Elements of Engineering Seismology, Seismic Behaviour of Traditionally-Built Constructions of India, Seismic Provision of Strengthening and Retrofitting Measures for Traditionally-Built Constructions, Brick and RCC Structures.

**CONSTRUCTION MANAGEMENT:** Significance of construction management, Construction Planning, .Organization, .Site Organization, Construction Labour, Control of Progress, Inspection and Quality Control, Accidents and Safety in Construction.

**REPAIR AND MAINTENANCE OF BUILDINGS:** Need for Maintenance, Agencies Causing Deterioration, Investigation and Diagnosis of Defects, Defects and their root causes, .Materials for Repair, maintenance and protection, Remedial Measures for Building Defects.

**PRESTRESSED CONCRETE:** Basic concept of prestressed concrete, Materials, Prestressing Methods, Bending and Shear Capacity, Losses in Prestressing.

**I.K.Gujral Punajb Technical University, Jalandhar**

**Subject: Syllabus for Written Test of Technical Assistant for Mechanical Engineering Stream and Workshop (against advertisement no: 506)**

**APPLIED MECHANICS:** Concept of engineering mechanics, Laws of forces, Moment: Centre of Gravity, Simple Machines.

**MECHANICAL ENGINEERING DRAWING:** Limits and fits, Intersection of following solids, Pipe Joints, Electrical Circuit Diagram, Instructional strategy.

**CRYSTALLOGRAPHY:** Fundamentals, Cast Iron: Different types of Cast Iron, manufacture and their usage, Steels, Non Ferrous Materials, Theory Of Heat Treatment, Engineering Plastics, Advanced Materials, Miscellaneous Materials.

**HYDRAULICS AND PNEUMATICS:** Introduction to Pressure and its Measurement, Flow of Fluids, Hydraulic System, Water Turbines and Pumps, Introduction to Oil Power Hydraulics and Pneumatics, Components of Hydraulic Systems, Components of Pneumatic Systems.

**THERMODYNAMICS:** Fundamental Concepts, Laws of Perfect Gases, Thermodynamic Processes on Gases, Laws of Thermodynamics, Air Standard Cycles, Air Compressors, Introduction to Heat Transfer, IC Engines, Fuel Supply and Ignition System in Petrol Engine, Fuel System of Diesel Engine, Cooling and Lubrication, Testing of IC Engines, Steam Turbines and Steam Condensers, Gas Turbines and Jet Propulsion.

**STRENGTH OF MATERIALS:** Concept of load, stresses and strain, Resilience: Moment of Inertia: Bending Moment and Shearing Force, Bending stresses, Columns, Torsion, Springs.

**WORKSHOP TECHNOLOGYI:** Cutting Tools and Cutting Materials Lathe Drilling, Boring, Shaping, Planning and Slotting, Broaching, Jigs and Fixtures, Cutting Fluids and Lubricants.

**MECHANICAL ENGINEERING DRAWING:** Introduction to drawing office equipment, through a visit to modern drawing office of an industry, I.C. Engine Parts, Boiler Parts, Cams, Gears.

**PRODUCTION MANAGEMENT:** Functions (Elements) of PPC, Plant Location, Layout and Material Handling, Inventory Control, Repair and Maintenance, Value Engineering, Cost Estimation and Control.

**REFRIGERATION AND AIR CONDITIONING:** Fundamentals of Refrigeration, Vapour Compression System, Refrigerants, Air Refrigeration, System Vapour Absorption System, Refrigeration Equipment, Air conditioning.

**WORKSHOP TECHNOLOGY:** Milling, Grinding, Gear Manufacturing and Finishing Processes, Modern Machining Processes, Metallic Coating Processes, Metal Finishing Processes.

**THEORY OF MACHINES:** Simple Mechanisms, Friction, Power Transmission, Flywheel, Governor, Balancing, Vibrations.

**COMPUTER AIDED DRAFTING:** Concept of AutoCAD, Detail and assembly drawing of the following using AUTOCAD, Isometric Drawing by CAD using Auto CAD.

**METROLOGY AND INSTRUMENTATION:** Metrology, Linear and Angular Measurement, Measurement of Surface Finish, Measurements of Screw threads and Gauges, Instrumentation, Quality Control.

**AUTOMOBILE ENGINEERING:** Automobile, Power System, Transmission System, Steering System, Braking system, Suspension System, Battery, Dynamo and Alternator, Exhaust Emissions.

**MACHINE DESIGN:** Design, Design terminology, Engineering materials and their mechanical properties, Design Failure, Design of Shaft, Design of Key, Design of Joints, Permanent Joint, Design of Flange Coupling, Design of Screwed Joints.

**CNC MACHINES AND AUTOMATION:** Introduction to NC, CNC & DNC, Construction and Tooling, Part Programming, System Devices, Problems in CNC Machines, Automation and NC system.

Syllabus for the test of Technical Assistant Mathematics

**ALGEBRA**

Relations between the roots and coefficients of general polynomial equation in one variable, Transformation of equations and symmetric function of roots, Descarte's rule of signs, Newton's Method of divisors, Solution of cubic equations by Cardon method, solution of biquadratic equations by Descarte's and Ferrari's Methods, De-Moivre's Theorem and its applications, circular and hyperbolic functions and their inverse, Exponential and Logarithm function of a complex numbers, Expansion of trigonometric functions, Gregory's series, Summation of series.

**CALCULUS AND ANALYSIS**

Real number system, its properties, lub, glb of sets of real numbers, limit of a function, Basic properties of limits, Continuous functions and classification of discontinuities, Uniform continuities, differentiation of hyperbolic functions, Successive differentiation. Leibnitz theorem. Taylor's and Maclaurin's theorem with various forms of remainders, Indeterminate forms, Tracing of Curves (Cartesian and Parametric coordinates only). Determination of Radius of convergence of power series.

Definition and existence of Riemann integrals. Properties of integrals. Integrability of continuous and monotonic functions. The fundamental theorem of integral calculus. Mean value theorem of integral calculus.

Definition of a sequence, Bounded and Monotonic sequences, Convergent sequence, Cauchy sequences, Cauchy's Convergence Criterion, Theorems on limits of sequences. Subsequence, Sequential continuity. Definition of a series, test of convergence of positive term aeries (Without proofs).

**ADVANCED CALCULUS**

Multivariable Functions: Functions of several variables. Limits and continuity. Change of variables. Partial derivation and differentiability of real-valued functions of two variables. Statements of Inverse and implicit function theorems and applications. Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables. Jacobins. Envelopes. Evolutes. Maxima, Minima and saddle points of functions of two variables. Lagrange's undetermined multiplier method. Extreme values and saddle points. Double integrals. Double integrals in Polar Form. Triple integrals in Rectangular co-ordinates. Triple integrals in Cylindrical and Spherical co-ordinates.

**VECTOR CALCULUS**

Scalar and vector fields, differentiation of vectors, Directional derivatives, Gradient vectors and tangent planes, velocity and acceleration. Vector differential operators: Del, Gradient, Divergence and Curl, their physical interpretations. Formulae involving Del applied to point functions and their products. Line, surface and volume integrals, Green's Theorem in the Plane Parameterized Surface, Stoke's Theorem and the Divergence Theorem. Applications of Green's, Stoke's and Divergence theorem.

*Approved*  
18.09.2018

## LINEAR ALGEBRA

Definition of groups, rings and fields with illustrations. Definition of vector spaces, subspaces with examples. Direct sum of subspaces. Linear span, Linear dependence, Linear independence of vectors. Linear combination of vectors. Basis of a vector space, Finitely generated vector spaces. Existence theorem for basis. Invariance of the number of elements of the basis set.

Linear transformation. Algebra of linear transformation. Rank of a matrix, Eigen values, eigen vectors and the characteristic equation of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix, Rank- Nullity theorem, Isomorphism and Isomorphic spaces, Matrix of a linear transformation. Changes of basis, Linear operator. Characteristic polynomials and characteristic roots, minimal polynomials.

## ORDINARY DIFFERENTIAL EQUATIONS

Exact differential equations, First order and higher degree equations solvable for  $x$ ,  $y$ ,  $p$ . Clairaut's form and singular solutions, Geometrical meaning of a differential equation, Orthogonal trajectories, Linear differential equations with constant and variable coefficients, Variation of Parameters method, reduction method, series solutions of differential equations. Power series method, Bessel and Legendre equations (only series solution).

## COORDINATE GEOMETRY

Pair of Straight lines: Joint equation of pair of straight lines and angle between them, condition of parallelism and perpendicularity, joint equation of the angle bisectors, joint equation of lines joining origin to the intersection of a line and a curve.

Circle: General equation of circle, circle through intersection of two lines, Tangents and Normals, Chord of contact, pole and polar, pair of tangents from a point, equation of chord in terms of midpoint, angle of intersection and orthogonality, power of a point w.r.t circle, radical axis, co-axial family of circles, limiting points.

Conic: General equation of conic, Tangents, normals, chord of contact, pole and polar, of tangents from a point, equation of chord in terms of midpoint, diameter. Conjugate diameters of ellipse and hyperbola, special properties of parabola, ellipse and hyperbola, conjugate hyperbola, asymptotes of hyperbola, rectangular hyperbola. Transformation of axes in two dimensions: shifting of origin, rotation of axes, the second degree equation  $S=ax^2+2hxy+by^2+2gx+2fy+c=0$ , its invariants  $t$ ,  $\Delta$  and  $O$ . Reduction of the second degree equation into standard form. Identification of curves represented by  $S=0$  (including pair of lines) Polar coordinates: Polar equations of straight lines, circles and conics. Polar equation of chords, tangents and normals only.

## ANALYTIC GEOMETRY

**The plane:** General form, Normal form, Intercept form, Reduction of the general form to normal form, Equation of plane through three points, Angle between two planes, Parallel planes, Perpendicular distance of a point from the planes, Pair of the planes, Area of a triangle and volume of a tetrahedron.

**The straight line:** Equation of a line in general form, Symmetric form, two point form, Reduction of the general equation to the symmetrical form, Straight line and the planes, Conditions of parallelism and perpendicularity of a line and a plane, Plane through a given line, Perpendicular distance formula for the line, Projection of a line on a given plane containing

*Apurva*  
18.09.2018



them, Condition of intersection of two lines, Shortest distance between two lines, intersection of three planes.

**Sphere:** General equation of a sphere, Plane section of a sphere, Intersection of two spheres, Sphere through a given circle, Intersection of a straight line and a sphere, Equation of a tangent plane to sphere, Condition of tangency. Plane of contact, Orthogonal Spheres, Angle of intersection of two spheres, Length of tangent, Radical plane, Coaxial system of spheres.

**Cone:** Equation of a cone whose vertex is at origin, Equation of a cone with a given vertex and a given conic as base, Condition that general equation of second degree represent a cone, Equation of a tangent plane, Condition of tangency of a plane and a cone, Reciprocal cone, Right circular cone.

## STATICS AND DYNAMICS

Basic notation, Newton Laws of motion, system of two forces, parallelogram law of forces, resultant of two collinear forces, resolution of forces, moment of a force, couple, theorem on moments of a couple, coplaner forces, resultant of three coplanar concurrent forces, theorem of resolved parts, resultant of two forces acting on a rigid body, Varignon's theorem, generalized theorem of moments. Equilibrium of two concurrent forces, equilibrium condition for any number of coplanar concurrent forces, Lami's theorem.  $\lambda - \mu$  theorem, theorems of moments, resultant of a force and a couple. Equilibrium conditions for coplanar non-concurrent forces.

Motion of a particle with constant acceleration, acceleration of falling bodies, motion under gravity, motion of a body projected vertically upward, motion of a two particles connected by a string, motion along a smooth inclined plane, constrained motion along a smooth inclined plane. Variable acceleration: Simple harmonic motion, elastic string, curvilinear in a plane, Definition of velocity and acceleration, Projectile, motion in a circle, motion under constraints, central force motion. Work, Power, conservative fields and potential energy, work done against gravity, potential energy of a gravitational field. Relative motion, relative displacement, velocity and acceleration, motion relative to a rotating frame of reference. Linear momentum, angular momentum, conservation of angular momentum, impulsive forces, principle of impulse and momentum, motion with respect to centre of mass of a system of particles, collisions of elastic bodies, loss of energy during impact. Free vibration, the simple pendulum, the conical pendulum. Central Orbit. Kepler's laws of motion.

*Accepted*  
12.09.2017

IKG Punjab Technical University, Kapurthala

Department of Physical Sciences

Syllabus for the test of Technical Assistant Physics

**Mechanics**

Laws of motion, motion in a uniform field, components of velocity and acceleration in different coordinate systems, uniformly rotating frame, centripetal acceleration, Coriolis force and its applications. Motion under a central force, Kepler's law, Gravitational law and field. Potential due to a spherical body, Gauss and Poisson equations for gravitational self-energy

System of particles, center of mass, equation of motion, conservation of linear and angular momenta, conservation of energy, single-stage and multistage rockets, elastic and inelastic collisions.

Rigid body motion, rotational motion, moments of inertia and their products, principal moments and axes. Euler's equations.

**Oscillations**

Potential well and periodic oscillations, case of harmonic oscillations, differential equation and its solution, kinetic and potential energy, examples of simple harmonic oscillations, spring and mass system, simple and compound pendulum, torsional pendulum, bifilar oscillations, Helmholtz resonator, LC circuit, vibrations of a magnet, oscillations of two masses connected by a spring.

Superposition of two simple harmonic motions of the same frequency along the same line, interference, superposition of mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies

Two coupled oscillators, normal modes, N coupled oscillators, damped harmonic oscillators, power dissipation, quality factor, examples, driven harmonic oscillator, transient and steady states, power absorption, resonance in systems with many degree of freedom.

**Electricity and Magnetism**

Scalars and vectors, dot and cross products, triple vector product, gradient of a scalar field and its geometrical interpretation, divergence and curl of a vector field, line, surface and volume integrals, flux of a vector field, Gauss's divergence theorem, Green's theorem and Stokes theorem. Functions of two and three variables, partial derivatives, geometrical interpretation of partial derivatives of functions of two variables, Total differential of a function of two and three variables, higher order derivatives, applications. Steady current, current density  $J$ , non-steady currents and continuity equation, Kirchoff's law and analysis of multiloop circuits, rise and decay of current in LR and CR circuits, decay constants, transient in LCR circuits, AC circuits, complex numbers and their applications in solving AC circuit problems, complex impedance and reactance, series and parallel resonance, Q factor, power consumed by an AC circuit, power factor, Y and  $\Delta$  networks and transmission of electric power. Force on a moving charge; Lorentz force equation and definition of  $B$ , force on a straight conductor carrying current in a uniform magnetic field, torque on a current loop, magnetic dipole moment, angular momentum and gyromagnetic ratio. Biot and Savart's Law, Calculation of  $H$  order in a simple geometrical situation, Ampere's Law  $\text{div } B = 0$ ,  $\text{curl } B = \mu_0 J$ , field due to a magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as a surface distribution of solenoidal current. Electromagnetic induction, Faraday's law, electromotive force,  $\epsilon = \int E \cdot dr$ , integral and differential

forms of Faraday's law, mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, electromagnetic field energy density. The wave equation satisfied by E and B, plane electromagnetic waves in vacuum, Poynting's vector, reflection at a plane boundary of dielectrics, polarization by reflection and total internal reflection, Faraday effect, waves in a conducting medium, reflection and refraction by the ionosphere.

## **Waves, Acoustics, Optics and Lasers**

### *Waves*

Waves in media. Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, typical measurements. Waves over liquid surface: gravity waves and ripples. Group velocity and phase velocity: their measurements. Superposition of waves. Linear homogeneous equations and the superposition principle, nonlinear superposition and consequences. Standing waves: Standing waves as normal modes of bounded systems, examples. Harmonics and the quality of sound: examples. Chladni's figures and vibrations of a drum. Production and detection of ultrasonic and infrasonic waves and applications.

### *Acoustics*

Noise and Music: The human ear and its responses, limits of human audibility, intensity and loudness, bel and decibel, the musical scale, temperament and musical instruments. Reflection, refraction and diffraction of sound. Acoustic impedance of a medium, percentage reflection and refraction at a boundary, impedance matching for transducers, diffraction of sound, principle of a sonar system, sound ranging.

Applied acoustics: Transducers and their characteristics. Recording and reproduction of sounds, various systems. Measurements of frequency, waveform, intensity and velocity. The acoustics of halls, reverberation period, Sabine's formula.

### *Geometrical Optics*

Fermat's Principle. Principle of extremum path, the aplanatic points of a sphere and other applications. General theory of image formation. Cardinal points of an optical system, general relationships, thick lens and lens combinations, Lagrange equation of magnification, telescopic combinations, telephoto lenses and eyepieces. Aberration in images. Chromatic aberrations, achromatic combination of lenses in contact and separated lenses. Monochromatic aberrations and their reductions, aspherical mirrors and Schmidt corrector plates, aplanatic points, oil immersion objectives, meniscus lens. Optical instruments. Entrance and exit pupils, need for a multiple lens eyepiece, common types of eyepieces.

### *Physical Optics*

Interference of a light: The principle of superposition, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localised fringes: thin films, applications for precision measurements for displacements. Haidinger fringes: Fringes of equal inclination. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Twyman-Green interferometer and its uses. Intensity distribution on a multiple beam interference. Tolansky fringes, Fabry-Perot interferometer and etalon. Fresnel diffraction: Fresnel half-period zones, plates, straight edge, rectilinear propagation. Fraunhofer diffraction: Diffraction at a slit, half-period zones, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscope systems, outline of phase

microscopy. Diffraction gratings: Diffraction at  $N$  parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving power of prism and of a Fabry-Perot etalon. Double refraction and optical rotation. Refraction in uniaxial crystals, its electromagnetic theory. Phase retardation plates, double image prism. Rotation of plane of polarisation, origin of optical rotation in liquids and in crystals.

### **Lasers**

Laser system: Purity of a spectral line, coherent length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, Spontaneous and induced emissions, conditions for laser action, population inversion.

Application of lasers: Pulsed lasers and tunable lasers, spatial coherence and directionality estimates of beam intensity, temporal coherence and spectral energy density.

Laser and nonlinear optics: Polarization  $P$  including higher order terms in  $E$  and generation of harmonics, momentum mismatch and choice of the right crystal and direction for compensation.

### **Quantum Mechanics**

Black body radiation, Planck's theory, photoelectric effect, Compton effect, Frank-Hertz experiment, Uncertainty principle, Wave-particle duality, deBroglie theory, Davisson-Germer experiment, Schrodinger equation with application to simple potential problems, Reflection and transmission at a step potential, tunneling through a barrier.

### **Atomic and Molecular Physics**

Born, Sommerfeld and vector atom model, Quantum states of electron in atoms, Hydrogen atom spectrum, Electron spin, Zeeman effect, Stern-Gerlach experiment, Spin-orbit interaction, Two electron systems, various coupling schemes, fine structure, deuterium and alkali atoms spectra, spectroscopic terms and selection rules, Hyperfine structure, Raman spectroscopy, X Rays spectrum, Mosley's law, double structure of x rays, absorption spectra.

### **Nuclear and Particle Physics**

Structure of Atomic nucleus, mass and Binding energy, Nuclear forces, Nuclear spin, Magnetic moment, Liquid drop and shell models, Radioactivity and its applications, Laws of radioactive decays, Fission and fusion, Interaction of charged particle and neutron with matter, working of nuclear detectors, Particle Physics: Properties and origin, Elementary particles, Properties, classification, type of interactions and conservation laws, Strange particles and Strangeness quantum number, Simple ideas of group theory, various symmetry and conservation laws, CPT invariance.

## Chemistry

### **Inorganic Chemistry**

**Atomic Structure** Heisenberg uncertainty principle, Schrodinger wave equation, Aufbau and Pauli exclusion principles, Hund's multiplicity rule and periodic Properties of elements

**Chemical Bonding** Covalent Bond-Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions and valence shell electron pair repulsion (VSEPR) theory.

**S, p, d and f Block Elements** General characteristics properties, Comparative studies, diagonal relationship, salient features.

**Oxidation and Reduction** Use of redox potential data, analysis of redox cycle, redox stability in water, principles involved in the extraction of the elements

**Coordination Compounds** Werners coordination theory, Effective atomic number, chelates, nomenclature, isomerism Valence bond theory

**Acids and Bases** Arrhenius, Bronsted -Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases and Hard and Soft Acids and Base concept.

**Metal-ligand Bonding in Transition Metal Complexes** limitations of valence bond theory, an elementary idea of crystal field theory, CF splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters.

**Magnetic Properties of Transition Metal Complexes** Types of Magnetic behavior, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of  $\mu_s$  and  $\mu_{eff}$  values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

**Electron Spectra of Transition Metal Complexes** Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel energy level diagram for  $d^1$  and  $d^9$  states, discussion of the electronic spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  complex ion.

**Thermodynamic and Kinetic Aspects of Metal Complexes** thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes

**Organometallic Chemistry** Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, Metal-alkyls, metal-carbenes and metal-carbynes.

**Bioinorganic Chemistry** Essential and trace elements in biological processes, metalloporphyrins, haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to  $\text{Ca}^{2+}$ , Nitrogen fixation

**Silicones and Phosphazenes** Silicones and Phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

### **Organic Chemistry**

**Structure and Bonding** Hybridization, bond lengths, bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clathrates, charge transfer complexes resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

**Mechanism of Organic Reactions** Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents- electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates (carbocations, carbanions, free radicals, carbenes, arynes and nitrenes). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

**Stereochemistry of Organic Compounds** Isomerism and its types, Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro, diastereomers, meso compounds.

resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism - determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism - conformational analysis of ethane and n-butane; conformational analysis of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivative. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

Introduction, IUPAC nomenclature. Isomerism and classification, Methods of preparation, chemical properties of **Alkanes, Cycloalkanes, Alkenes, Cycloalkenes, Dienes, Alkynes, Alkenes, Cycloalkenes, Dienes and Alkynes, Alkyl halides, Aryl Halides, Alcohols, phenols, Aldehyde and Ketones, ethers, epoxide, carboxylic acid derivatives**

**Arenes and Aromaticity** Nomenclature of benzene derivatives, Aryl group, Aromatic nucleus and side chain. Structure of benzene: Molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: The Huckel rule, aromatic ions, Aromatic electrophilic substitution - general pattern of mechanism, role of sigma and pi complexes. Methods of formation and chemical reactions.

**Organic Spectroscopy** Fundamentals and basic techniques of Ultraviolet, Infrared and NMR spectroscopy.

**Organic Compounds of Nitrogen** Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, Mechanisms of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline media. Reactivity, Structure and nomenclature of amines, Methods of preparation of amines by Reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction and Hofmann bromamide reaction. Physical properties. Stereochemistry of amines. separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts.

**Spectroscopy** Nuclear Magnetic Resonance Spectroscopy Proton Magnetic resonance spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problem pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

**Organometallic Compounds** the Grignard reagents-formation, structure and chemical reactions, organozinc compounds: Formation and chemical reactions, Organolithium compounds: formation and chemical reactions

## Physical Chemistry

**Gaseous States** Postulates of kinetic theory of gases, ideal behaviour, van der Waal's equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state. Molecular Velocities.

**Liquid State** Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals.

**Colloidal State** Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical, properties, stability of colloids, protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions).

**Solutions, Dilute Solutions and Colligative Properties** Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties.

**Thermodynamics** Definition of thermodynamic terms: System, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Second Law of Thermodynamics: Need for the law, different statements of the law, Carnot cycle and its efficiency, Carnot

theorem. Concept of Entropy : Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

**Chemical Equilibrium** Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Determination of  $K_p$ ,  $K_c$ ,  $K_a$  and their relationship, Clausius-Clapeyron equation, applications. Introduction to Phase Equilibrium, Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water,  $\text{CO}_2$  and S systems. Phase equilibria of two component systems-solid-liquid equilibria, simple eutectic-Bi-Cd, Pb-Ag systems.

**Electrochemistry** Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, determination of  $K_a$  of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas metal ion, metal ion, metal insoluble salt-anion and redox electrodes. Electrode reactions. Nernst equation, derivation of cell E.M.F. and Single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance.

**Nuclear Chemistry** Introduction: Radioactivity, Nuclear Structure, Size of Nucleus, Mass Defects and Binding Energy, Nuclear Stability, Nuclear Forces, Nuclear Spin and Moments of Nuclei, Nuclear Models, Nuclear Decay Processes, The Laws of Radioactive Decay, Soddy-Fajans Group Displacement Law, Rate of Nuclear Decay and Half Life Time (Kinetics of Radioactive Decay), Induced Nuclear Reactions Types of Nuclear Processes, High Energy Nuclear Reactions, Nuclear Reaction Cross-Section, Artificial radioactivity, Detection and Measurement of Radioactivity, Nuclear Fission, Nuclear Fusion, Applications of Radioactivity.

**Spectroscopy** Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom. Rotational Spectrum, Vibrational Spectrum and Electronic Spectrum, Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle. Qualitative description of s, p, and n M.O., their energy levels and the respective transitions.

**Quantum Mechanics** Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids. Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect, de Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance. physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box, quantization of energy levels, extension to two and three dimensional boxes, degeneracy. Simple harmonic oscillator model of vibrational motion, setting up Schrodinger equation and discussion of solution and wave functions. **Solid State** Definition of space lattice and unit cell, Law of crystallography- (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices, (iii) Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's Law in Reciprocal space. Determination of crystal structure of NaCl, KCl by use of Powder method; Laue's method.

**Photochemistry** Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

## Screening Exam Syllabus for the Post of Technical Assistant Food Science and Technology

Food spoilage-sources. General principles of food processing and preservation by additives, high and low temperature, drying, irradiation, sugar, salt. Introduction to microbiological techniques: sterilization techniques, staining techniques, techniques for isolation of bacteria. Microbiological analysis of food products: bacterial count, yeast and mold count, coliform count. Microbiological testing of water. Food laws and food safety (HACCP, GMP, GHP, ISO 9000 series, ISO 22000, Codex alimentarius, FPO, MPO, MMPO, FSSAI, BIS, PFA etc.), Food adulteration. Preparation of jams, jellies, marmalades, juices, squashes, ketchup, pickles and chutneys. Liquid milk processing, fermented milks. Preparation of milk products cheese, condensed and evaporated milk, whole and skim milk powder and ice cream. Proximate composition of cereals, flour and its use in bakery products bread, biscuits, cakes, doughnut and buns. Additives for bakery industry. Milling of different cereals, parboiling of rice. Composition, nutritive value and functional properties of eggs. Meat tenderization. Principles of meat preservation. Dimensions and Units. Material and energy balance. Unit operations in food processing. Role of microorganisms in fermented foods-bread, malt beverages, wine, vinegar, butter and cheese. Principles of food packaging, packaging materials, packaging methods and machinery. Packaging requirements for different food products.

Elements of mechanics, colligative properties, laws of thermodynamics, modes of heat transfer. Outlines in optics and sound, electromagnetic radiation

Concept of pH and buffer. Isomerism, structural and optical isomers, food chemistry, composition of foods, minerals in foods, water activity in foods, carbohydrates, mono and di-saccharides, reducing and non-reducing sugars, starch, cellulose, pectins, plant acids and proteins, primary, secondary and tertiary structures of proteins, protein denaturation, peptide bonds, amino acids, saturated and unsaturated fats, rancidity.

Theory of quadratic equations, binomial theorem, uses of natural and common logarithms, trigonometry, ratios and their relations, basics of matrices, vectors, determinants

Organization of animal tissues, nucleic acids, endocrine glands, digestion, absorption

*R. M. S.*  
11/08/17