

INFORMATION BROCHURE

DRDO Scientist Entry Test 2009



*A Unique DRDO Offer for Challenging Career Opportunities
as Scientists and Engineers in High-Tech Areas*



Recruitment & Assessment Centre (RAC)
Defence Research and Development Organisation
Lucknow Road, Timarpur, Delhi - 110 054

CONTENTS

I	Career in DRDO	1
II	General Information on SET 2009	2
III	Instructions for filling-up SET 2009 Application Form	4
IV	Item wise Instructions for filling the Application Form	5
V	Syllabi	11
Table 1	Subject Code and Discipline Code for Chemical Engg.	15
Table 2	Subject Code and Discipline Code for Computer Science & Engg.	15
Table 3	Subject Code and Discipline Code for Electronics & Commun. Engg.	15
Table 4	Subject Code and Discipline Code for Electrical Engineering	15
Table 5	Subject Code and Discipline Code for Mechanical Engineering	16
	CHECKLIST	16

I. CAREER IN DRDO

Are you a young and energetic person endowed with a high level of creative abilities, readiness to take up new challenges and inclination to treat learning and professional development as a lifetime passion?

Do you think of innovation as a way of life, have an achievement-orientation and eager to put your knowledge to practical use?

If yes, DRDO will find you wherever you are North, East, West or South and whatever is your discipline - science, engineering, medicine with specialization of relevance to DRDO. You name it and you will find one or more of DRDO's network of 52 laboratories with modern research facilities employing state-of-art technologies in your specialization.

Experience the thrill of working in the frontier areas of service and technology once you are a part of DRDO. Consider the range of technologies you may be associated with viz, missiles, computers, communications, avionics, weaponry, ammunition and a host of high facilities - be it in underwater, land or aerospace environments. DRDO has strategic alliances with well-known academic, production and R&D agencies.

DRDO is proud of its personnel selection system, which is objective, unbiased and transparent. On selection you will join the Organization as a Group 'A' Gazetted Officer of the Government of India in the Pay Band of Rs. 15600-39100, Grade Pay: Rs. 5400 at the entry level under the Defence Research & Development Service (DRDS).

DRDO takes utmost care in formulating innovative career advancement programmes for its scientists / engineers. It operates a flexible complementing promotion scheme, unconstrained by vacancies in higher echelons in the cadre. In simple terms, it means that with each promotion, based on your merit, your post is upgraded automatically.

Performance being the only criterion for promotion, one can aspire to rise to a level of an Outstanding Scientist in the Pay Band of Rs. 37,400-67,000, Grade Pay: Rs. 12,000. In addition to the basic pay, you would get attractive allowances / perks, including professional update allowance, advance increment/special pay etc.

DRDO places great emphasis on human resource development programmes for its scientists. The organization not only offers professionally challenging jobs but also provides adequate opportunities to its scientists to grow within and outside the organization and develop special skills.

From time to time, its scientists are trained at its own training institutes in Pune and Mussoorie. Also, they are sent to prestigious academic institutions for acquiring higher educational qualifications. A Continuing Education Programme, launched a couple of years ago, has now taken very strong roots in the organization. The focus is on improving existing professional skills and acquiring new knowledge in frontier disciplines. You may also find an opportunity for an overseas training or assignment for acquiring worldclass skills and expertise. Thus DRDO does everything possible to acquire cutting edge technological capabilities to be a global player and a technological force to reckon with.

In DRDO laboratories, one can feel a palpable openness and conducive working environment to achieve a high degree of self - actualization. Its research institute campuses are well equipped with housing and medical facilities, shopping centers and schools.

Here is a unique opportunity for you to join this prestigious organization. Look out for advertisements regarding recruitment, which will appear in national newspapers and on Internet (<http://rac.drdo.in>).

II. GENERAL INFORMATION ON SET - 2009

1. Subjects/Vacancies

Recruitment and Assessment Centre (RAC) conducts the Scientists Entry Test (SET) to shortlist candidates for the "Scientist B" (Pay Band of Rs. 15600-39100, Grade Pay: Rs. 5400) vacancies in DRDS. The SET 2009 examination will be conducted in **31 cities** (see section IV for details) on **Sunday, September 6, 2009 from 10:00 hrs to 13:00 hrs**. The subjects and the corresponding vacancies for SET 2009 are summarized in the table below.

SUBJECTS / VACANCIES FOR DRDO

Subject	Code	No. of Vacancies: 220				
		UR	OBC	SC	ST	Total
Electronics & Comm. Engineering	EC	41	21	12	06	80
Mechanical Engineering	ME	31	16	08	05	60
Computer Science & Engineering	CS*	20	11	06	03	40*
Chemical Engineering	CH	11	05	02	02	20
Electrical Engineering	EE	09	06	04	01	20

Note : Out of above reservation, 10 (01 current + 09 backlog) vacancies are reserved for PHP (Physically Handicapped persons), in which 05 vacancies are reserved for Orthopaedic Handicapped (OH) and 05 vacancies for Hearing Handicapped (HH) persons in the non-exempted disciplines marked with asterisk (). However, DRDS cadre in DRDO, has been exempted from the purview of Section-33 of Persons with Disability Act, 1995, in the areas of Chemical Engg, Electrical Engg., Electronics & Communication Engg and Mechanical Engg.*

Separate instructions have been provided in sections III and IV for filling the application form. These should be meticulously followed. Mail the duly filled in application form only by registered/speed post (P & T).

2. Eligibility

a. Qualifications

Essential: At least a first class Bachelor's degree in Engineering or Technology in Electronics & Communication Engg. / Mechanical Engg. / Computer Science & Engg. / Chemical Engg. / Electrical Engg. from a recognized University in the respective/relevant disciplines.

Note : If a class/division is not awarded at B.E./B.Tech or equivalent degree, a minimum of 60% marks in aggregate or 6.75 CGPA shall be considered equivalent for grade points on a ten-point scale

b. Age Limit

The upper age limit is 28 years (as on 5th June 2009).

Age relaxation: Maximum relaxation in upper age limit will be as under:-

- | | |
|--|-----------------------------------|
| i) Upto 05 years in case of SC/ST candidates | } for the posts reserved for them |
| ii) Upto 03 years in case of OBC candidates | |

- iii) Upto 05 years for Physically Handicapped Persons (10 years for SC/ST and 08 years for OBC candidates) in identified disciplines even if no posts are reserved for them in these areas.
- iv) In case of Ex-serviceman, services rendered in the armed forces plus 3 years

c. Nationality

Only Indian nationals need to apply.

Note : The applicants should ensure their eligibility themselves for SET-2009 in respect of age, essential qualification, first class etc. as the application forms are processed electronically and eligibility for the written test cannot be verified. For any query regarding eligibility for SET-2009, candidates may contact PRO, RAC at Telefax-011-23812608.

3. About SET - 2009

3.1 How to apply?

After ensuring that the above eligibility conditions are satisfied, candidates are required to apply in the **Electronically Scannable Application Form** specified for **DRDO SET - 2009**. The application form with information brochure containing the syllabus and instructions for filling up the form, will be available at designated Branches of State Bank of India as per the advertisement (visit <http://rac.drdo.in>) from **5th May 2009 to 5th June 2009** for General/OBC candidates on payment of Rs. 300/- (Rs. 100/- for the application form with information brochure and Rs. 200/- as Exam. Fees). For SC/ST candidates, there is no exam fee and the application form with information brochure will be available to them on payment of Rs. 100/- only. Form purchased from the designated branches of State Bank of India should be filled in accordance with the instructions given in information brochure. **However, for HH/OH candidates there is no Application/Examination fee. Such candidates may obtain Application Form free of cost from RAC by sending a request along with "Prescribed Disability Certificate" issued by Competent Authority mentioning their subject as per G.I., Dept. of Per. & Trg., O.M. No 36035/2004-Estt (Res), dated 29 Dec 2005.** The request for obtaining the form must reach Director RAC latest by **25th May 2009**, accompanied with two self addressed white slips of size 4" x 3". The envelope must indicate **"REQUEST FOR APPLICATION FORM SET - 2009 ADVT NO. – 94"**. The filled in application form should be submitted to **The Director, Recruitment & Assessment Centre, Lucknow Road, Timarpur, Delhi – 110054** by **5th June 2009**. The application form should be filled carefully without over writing, as these will be machine processed and no manual checking will be done. Onus of satisfying the eligibility requirements for appearing in the chosen subject lies with the candidate. In respect of applications sent by Registered / Speed post by candidates from Andaman & Nicobar Islands and Lakshadweep, closing date of receipt of applications is **15th June 2009**. Candidates appearing in the final examination (final semester) may also apply. However, candidates found eligible for interview, will be allowed to appear for the same only, if their final results are declared on or before **31st August, 2009**. **In case, results are delayed due to natural calamity, the candidates are required to bring along the proof/certificate from the competent authority at the time of interview.**

Note : Candidates are advised to keep a photocopy of the application form for use in future, which may be required at the time of interview.

3.2 SET - 2009 Details

The **DRDO SET** examination is of three hours duration. Each candidate appearing for the Test will be given one Question Booklet containing objective type questions, in two separate sections. **Section 'A'** will consists of **100 questions** to test the candidate's knowledge in the subject as per

syllabus given in Section V of this brochure. Each question will have 4 choices of which one only will be correct. Each correct answer will fetch 4 marks. For each incorrect answer, 1 mark will be deducted. **Section 'B'** will consist of **50 questions** to test the candidate's aptitude relevant to Applied Research & Development. Each question will have 4 choices of which one only will be correct. Each correct answer will fetch 2 marks. For each incorrect answer, ½ mark will be deducted. **Section 'B'** will test the candidate's aptitude relevant to Applied Research & Development. The distribution of 50 questions for Section 'B' is given below:

i.	Logical Relations	10 Questions
ii.	Spatial Reasoning	10 Questions
iii.	Concept Formation	10 Questions
iv.	Abstract Reasoning	10 Questions
v.	Numerical Reasoning	10 Questions
		50 Questions

The merit list will be prepared, based on the marks obtained by the candidates in Section 'A' and Section 'B' and this list will be used for short listing the candidates to be called for interview purely on merit basis limited to a reasonable number and subject to minimum qualifying criteria as decided by RAC.

The final selection of the candidates will be based purely on merit of their performance in the interview. In accordance with the subject-wise merit, the offer of appointment to the selected candidates will be restricted to the number of vacancies. However, the number of vacancies may vary. The appointment, however, will be subject to satisfying conditions like qualifying the Medical examination prescribed for Group 'A' Technical posts of Govt. of India with Field Service Liability and character verification, besides verification of SC/ST/OBC/HH/OH certificate if applicable. All Scientists 'B' to be inducted through DRDO SET 2009 will undergo **Post Induction Training (POINT)** at Pune. Selected candidates are liable to serve anywhere in India.

4. **IMPORTANT DATES:**

- **Forms available at SBI Branches: 5th May 2009 to 5th June 2009**
- **Last date of submission of Application forms : 5th June 2009**
- **Date and Time of Examination:**
Sunday, 6th September 2009; 10:00 – 13:00 hrs.

5. **Certificates**

Copies of certificates/testimonials regarding qualifications, caste, employment etc. should **NOT** be attached with the application form. Candidates, short-listed for interview after the test will, however, be required to produce original certificates for verification at the time of interview. Candidates serving in Central / State / Govt./ PSU/ Autonomous body etc. will be required to bring '**NOC**' from their respective Department / Employer at the time of interview failing which candidates will not be allowed to appear for the interview.

III. **INSTRUCTIONS FOR FILLING UP SET - 2009 APPLICATION FORM**

1. The application form will be processed by an Optical Mark Reader (OMR) machine. Therefore, it is important to follow all instructions very carefully.

2. Fill up the application form by using DARK (HB) Pencil only, except SIGNATURES and ADDRESS for which BLACK INK must be used.
3. For most items, you need to write in capital letters the required information in the boxes provided and then darken the appropriate bubble underneath each letter, using pencil only. In case of any discrepancy between the marked bubble and the corresponding text, the bubble will be taken as final. The text boxes are provided only for your guidance. Please ensure that you have darkened the appropriate bubble completely as shown here.

Correct



Wrong



4. Do not staple or pin anything to the application form.
5. Do not fold the form.
6. If you want to correct any entry, erase the previous mark completely using a soft eraser before correction. Please do not leave any smudges on the application form.
7. The lower portion of application form will be processed separately by a scanner. Make sure that your signature, address and photograph are within the boxes provided for the purpose.
8. Application No. available on the OMR application form will be referred for future reference.

IV. ITEM WISE INSTRUCTIONS FOR FILLING THE FORM

1. Name

Fill your name, as recorded in the High School (Class X) certificate by your Board/University/Institute, in CAPITAL LETTERS and darken the appropriate bubbles. If your name has more than 26 characters, abbreviate it suitable to accommodate within the space provided. For example, the name Karunakaran Shashidharan Vishwanathan can be abbreviated as Karunakaran S Vishwanathan.

K	A	R	U	N	A	K	A	R	A	N	S	V	I	S	H	W	A	N	A	T	H	A	N
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

2. Nationality

For Nationality, darken the appropriate bubble in item number 2.

3. Gender

For Gender, darken the appropriate bubble in item number 3.

4. Category

Fill your category as Unreserved (UR), Other Backward Class (OBC), Scheduled Caste (SC), Scheduled Tribe (ST) candidate by darkening the appropriate bubble available in the form. Hearing Handicapped (HH) or Orthopaedic Handicapped (OH) candidates should also darken the appropriate bubble HH or OH available in the form along with the category.

5. Date of Birth

Enter your date of birth as given in your High School (Class X) Certificate in the space provided.

Example: If the date of birth 7th January, 1983, fill in as
07/01/83
and darken the appropriate bubbles.

6. Choice of Subject

Choose one of the 5 subjects (CH, CS, EC, EE and ME) available in DRDO SET 2009 and darken the appropriate bubble in item 6. For each subject, the corresponding discipline codes are listed in Tables 1 to 5.

7. Discipline Code

Depending on the discipline of your qualifying degree, darken the appropriate bubble for the discipline code in item 7. The candidates are advised to ensure that their B.E./B.Tech degrees in Chemical Engineering / Computer Science & Engineering / Electronics & Communication Engineering / Electrical Engineering / Mechanical Engineering are in the same subject/discipline in which they are appearing for the test.

8. Choice of Test City

The following is the list of cities where DRDO SET 2009 will be conducted. Fill in the code of the city where you wish to appear for the exam and darken the appropriate bubble.

Note : No request for change of centre will be entertained after the submission of the application form; however, due to insufficient number of candidates in a centre or unforeseen circumstances, the centre may be changed to the nearest indicated centre of choice.

List of Test Cities

CITY	CODE
Agra	11
Ahmedabad	12
Amritsar	13
Bangalore	14
Bhopal	15
Bhubaneswar	16
Chandigarh	17
Chennai	18
Coimbatore	19
Dehradun	20
Delhi	21
Guwahati	22
Gwalior	23
Hyderabad	24
Jaipur	25
Jammu	26

CITY	CODE
Jodhpur	27
Kanpur	28
Kochi	29
Kolkata	30
Lucknow	31
Mumbai	32
Nagpur	33
Patna	34
Pune	35
Raipur	36
Ranchi	37
Shimla	38
Siliguri	39
Thiruvananthapuram	40
Visakhapatnam	41
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9. Institute / University

Darken the appropriate bubble for the type of institution (IIT, NIT, State University, Central University, Deemed University, etc.) from which the qualifying degree has been / is to be obtained.

10. Degree Code

Darken the correct Degree Code as indicated below:

Degree	Degree Code
B.E./B.Tech./ B.Sc. (Engg.)/B.Sc. (Tech.)	E
Integrated M.E./M.Tech./Dual Degree	M
Professional (AMIE etc.)	P

**** Please note that MCA/ M.Sc. or any other qualification in Science will not be considered equivalent to B.E./B.Tech advertised for Engineering subjects/ disciplines.**

11. PERCENTAGE of Marks obtained in BE/ B. Tech. / B.Sc. (Engg.)/ B.Sc. (Tech.)
(If already passed).

Indicate percentage of the marks obtained in your degree examination if already passed. Round off the marks to single decimal place. If you are yet to receive the marks from the qualifying degree examination, leave this field blank.

12. E mail

Write your e-mail address in the boxes provided in the item number 12. ***Any change in E-mail Address should be immediately communicated to RAC .***

13. Photograph

Paste a recent passport size clear front facial colored photograph (size 4 cm height x 3 cm width) in the box provided. Ensure that the photograph is pasted within the box. The photograph should NOT be attested or signed by anyone. The photograph will be scanned and the scanned image will appear on the admit card.

14. Mailing Address

Write the address for communication in CAPITAL letters using BLACK INK. Your address should include your NAME and PIN CODE. Write within the box only.

NOTE: Scanned copy of this address will be used directly in all correspondence. Hence, it should be clear and legible. Any change in Address should be immediately communicated to RAC .

15. Signature

Put your signature in **BLACK INK** in the box provided. Please note that the APPLICATION FORM must be signed only by the candidate himself/ herself and not by any other person such as parent/ guardian/ friend. The signature will be scanned and put on the Admit Card. If the candidate's signature on the answer script does not match with the signature on the form, his/her candidature will be cancelled. Signature in the form of all capital letters will not be considered as a valid signature.

Do not write or make any mark over the barcode. Any tampering of the barcode will render your application invalid.

16. Parent/Guardian Name

Write the name of your parent / guardian in the boxes provided and darken the appropriate bubbles given underneath in item 16.

17. Relationship

Indicate your relation with the person mentioned in 16 above by darkening the appropriate bubble in item 17.

18. Date of Application

Indicate the date of application by darkening the appropriate bubble in item number 18.

19. Contact Number with STD Code/Mobile Number

Give your contact phone number (land line with STD code or Mobile) in the boxes provided and darken the appropriate bubble. If you do not have phone, leave this blank. *Any change in Phone No. should be immediately communicated to RAC .*

20. State of Qualifying Degree

Darken the appropriate bubble for the State from which you have obtained / will be obtaining the qualifying degree.

21. PINCODE of Address for Communication

Write the pin code of your address in the boxes provided and darken the appropriate bubbles.

22. Areas of Interest

Depending on your area of interest, darken the bubble for the appropriate code in item 22, as per the details given below:

Basic Research (BR), Design (DE), Development (DV), Modeling & Simulation (MS), R&D Management (RD), Testing & Quality Assurance (TQ), Teaching/Research (TR) and Technical Service (TS).

Basic Research (BR)

Basic research is driven by a scientist's curiosity or interest in specific scientific problems. The main motivation is to expand his/ her knowledge base and invent something new or novel.

Design (DE)

The activities under this category design of a component, system, product, process, material, software and allied systems relevant to physical, chemical, biological and engineering sciences. The initial task of a design assignment is to transform a well explained technical requirement of a user into a detailed design specification. The next step is to employ engineering knowledge and skills to select or evolve design methodology or strategy to

evaluate engineering dimension, evolve engineering drawing for fabrication or assembling and undertake subsequent installation. The design activities are generally conducted in two phases viz., basic and detailed design. The finalization of a design can be an interactive process with necessity for the design engineer to interact with the user and / or a development engineer.

A designer has to be well versed about the physics of the problem, fluid dynamics, thermodynamics (momentum and energy transfer) and construction materials and their properties.

Development (DV)

The activities under this category cover engineering and allied efforts needed to develop a modified or new component, system, product, process, material, software and allied systems of relevance to physical, chemical and biological and engineering sciences. The first task of a Development Engineer is to transform the customer's job requirements into technical specifications which will be later transformed into design specification by the Design Engineers. The next task is to establish new or use the existing experimental facilities to collect process or product development data to find answers to the problems associated with the specified functions including physical, interface and integration requirements.

A Development Engineers or a Scientist has to be well versed in experimentation and the ability to address the problems associated with equipment/ component fabrication, computer hardware/ software support, system integration, testing protocols and quality assurance.

Modeling and Simulation (MS)

It employs mathematical representation (or a model) for describing a system's behavior including its physico chemical and transport properties. The mathematical models can conveniently be used to investigate the impact of the changes of operating or process parameters on the overall performance of the System. Modeling can be used to compare the performance of an existing or a newly designed system with a reference system for a validation process. In aeronautics and power sector, it can be used to develop simulators for training of operating staff in their major installations. It can also be used as a design tool in case of complex process systems like a chemical plant. A scientist involved in modeling and simulation should have the ability to visualize the physical and mathematical representation of a given system and its dynamics.

R&D Management (RD)

The DRDO scientist may be fully or partially involved in R&D Management activities covering project planning (micro and macro), budgeting and monitoring, information management, project / group / institutional leadership, human resource development and management, chairmanship or membership of administrative committees. Special emphasis is being accorded by DRDO for human resource management by scientists with high level of professional skills in human performance management.

The DRDO is served by exclusive Human Resource Development departments at corporate and laboratory levels. Attempts are being made to evolve attractive career development programs for DRDO scientists at various levels.

The R&D Manager in DRDO laboratories and establishments have to possess special skills in HRD, project/ discipline/ institutional leadership and planning, budgeting and execution of

major and medium sized projects. Several scientists head the Technical Directorates at DRDO level in which above activities are executed on day to day basis.

Testing and Quality Assurance (TQ)

A variety of physical, chemical, biological and engineering tests have to be carried out to test a product, component, material or a system being developed in a research institution. The challenges of a testing and quality assurance job development or complication of new test protocols, identification, calibration and commissioning of test facility, execution of tests as per standard methods, development of testing methods and facilities of new systems under development. In some cases, acceptance testing has to be done under real user environment.

The engineer or scientist specializing in testing and quality assurance should have adequate knowledge of the theory behind the testing, statistical analysis of the results, international standard test and implications of test accuracy of the product quality.

Scientists engaged in technical services have to be well versed with operational aspects of major infrastructural facilities, their maintenance strategies, troubleshooting to improve system performance, intricacies of equipment fabrication and allied activities.

Teaching / Research (TR)

The activities under this category involve teaching and imparting training to the scientist and service officers in the areas of basic / advanced science & technology relevant to DRDO armed forces. It may also involve scientific contribution towards project / research activities. Besides above it may involve carrying out research / development activities in any of the DRDO Laboratory.

Technical Services (TS)

Scientists are engaged in specific technical service in DRDO system covering activities like operation and maintenance of complex process systems, fabrication engineering, installation and commissioning of major equipments/ facilities, trouble shooting of various systems and allied activities. During the execution of these jobs, the scientists will acquire special technology or technical competencies. The technical services can also cover activities like modifications to the existing codes and changes to the present hardware configuration to meet special needs.

23. Declaration

Put your signature in black ink and also indicate the place and date. Also, write your e-mail address, if available.

Enclose the complete application in the envelope provided (please read the instruction on the envelope) and send it by registered/speed post to the **The Director, Recruitment & Assessment Centre (RAC), Defence Research and Development Organization, Lucknow Road, Timarpur, Delhi – 110054** to reach on or before **5th June 2009**. For applications sent by post, by candidates from Andaman & Nicobar Islands, Lakshadweep, closing date of receipt of applications at RAC is **15th June 2009**.

V. SYLLABI

1. Chemical Engineering - CH

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

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

Heat Transfer: Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

Mass Transfer: Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stagewise and continuous contacting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

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

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

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

Chemical Technology: Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers.

2. Computer Science and Engineering - CS

Theory of Computation: Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability; NP-completeness.

Digital Logic: Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

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

Programming and Data Structures: Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

Algorithms: Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching.

Compiler Design: Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

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

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

Computer Networks: ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers.

3. Electronics and Communication Engineering - EC

Networks: Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

Electronic Devices: Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and avalanche photo diode, Basics of LASERS. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

Analog Circuits: Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single-and multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers. Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations. Function generators and wave-shaping circuits, 555 Timers. Power supplies.

Digital Circuits: Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor(8085): architecture, programming, memory and I/O interfacing.

Signals and Systems: Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

Control Systems: Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

Communications: Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift

keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Electromagnetics: Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain.

4. Electrical Engineering - EE

Electric Circuits and Fields: Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

Signals and Systems: Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

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

Power Systems: Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

Control Systems: Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

Electrical and Electronic Measurements: Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

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

Power Electronics and Drives: Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters - fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

5. Mechanical Engineering - ME

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

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

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

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

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

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

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

Applications: *Power Engineering:* Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines:* air-standard Otto, Diesel cycles. Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. *Turbomachinery:* Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.

Engineering Materials: Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

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

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

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

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

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

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

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

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

Table 1: Subject Code, Discipline Code and Equivalents for Chemical Engineering [CH]

S. No.	Degree	Subject Code	Discipline Code
1.	Chemical Engg/Tech	CH	1
2.	Chemical Plant Engg	CH	2
3.	Process Engg & Design	CH	3
4.	Any other equivalent Engg. degree	CH	0

Table 2: Subject Code, Discipline Code and Equivalents for Computer Science & Engineering [CS]

S. No.	Degree	Subject Code	Discipline Code
1.	Computer Science & Engineering	CS	1
2.	Computer Science & Automation Engg.	CS	2
3.	Computer Science & Information Tech.	CS	3
4.	Computer Science & System Engg.	CS	4
5.	Computer Technology	CS	5
6.	Computer Technology & Informatics Engg.	CS	6
7.	Information Science / Technology Engg.	CS	7
8.	Information & Communication Tech.	CS	8
9.	Software Engineering	CS	9
10.	Any other equivalent Engg. degree	CS	0

Table 3: Subject Code, Discipline Code and Equivalents for Electronics & Communication Engineering [EC]

S. No.	Degree	Subject Code	Discipline Code
1.	Electronics Engineering	EC	1
2.	Electronics & Communication Engg.	EC	2
3.	Electronics & Control Engineering	EC	3
4.	Electronics & Instrumentation Engg.	EC	4
5.	Electronics & Telecomm. Engineering	EC	5
6.	Electronics & Electrical Commun. Engg.	EC	6
7.	Electrical with Commun. Engg.	EC	7
8.	Industrial Electronics Engg.	EC	8
9.	Digital Electronics Engg.	EC	9
10.	Any other equivalent Engg. degree	EC	0

Table 4: Subject Code, Discipline Code and Equivalents for Electrical Engineering [EE]

S. No.	Degree	Subject Code	Discipline Code
1.	Electrical Engineering	EE	1
2.	Electrical & Electronics Engineering.	EE	2
3.	Electrical & Power Engineering	EE	3
4.	Power Electronics Engg.	EE	4
5.	Any other equivalent Engg. degree	EE	0

Table 5: Subject Code, Discipline Code and Equivalents for Mechanical Engineering [ME]

S. No.	Degree	Subject Code	Discipline Code
1.	Mechanical Engineering	ME	1
2.	Production Engineering.	ME	2
3.	Design & Production Engineering.	ME	3
4.	Industrial Engineering.	ME	4
5.	Automobile Engineering.	ME	5
6.	Manufacturing Science & Engineering.	ME	6
7.	Any other equivalent Engg. degree	ME	0

**** Please note that MCA/ M.Sc. or any other qualification in Science will not be considered equivalent to B.E./B.Tech advertised for Engineering subjects/ disciplines.**

CHECKLIST

Please ensure that you have :

<input type="radio"/>	<i>Pasted your recent passport size photograph</i>
<input type="radio"/>	<i>Indian nationality</i>
<input type="radio"/>	<i>The prescribed age limit</i>
<input type="radio"/>	<i>Passed your BE / B.Tech. / BSc(Engg) / BSc(Tech) in first division/class else if your result is awaited then your result should get declared on or before 31Aug 2009</i>
<input type="radio"/>	<i>Qualifying degree in relevant discipline as per Item no.7</i>
<input type="radio"/>	<i>Relevant qualifying degree as per Item no. 10</i>
<input type="radio"/>	<i>Signed the application form</i>
<input type="radio"/>	<i>Filled the date of application</i>
<input type="radio"/>	<i>Kept a Xerox copy of your application form for future use, which may be required at the time of interview</i>

The applicants should ensure their eligibility themselves for SET-2009 in respect of age, essential qualification, first class etc. and may refer information brochure carefully as the application forms are processed electronically and eligibility for the written test cannot be verified. For any query regarding eligibility for SET-2009, candidates may contact PRO, RAC at Telefax-011-23812608.

Important Dates :

Date of commencement of issue of Application Form & Information Brochure at Designated Bank Counters and RAC. 05.05.2009

Last Date for :

- (a) Issue of Application Form & Information Brochure at Designated Bank Counters. 05.06.2009
- (b) Receipt of request for issue of Application Form by Post addressed to The Director, RAC. 25.05.2009
- (c) Receipt of completed Application Form at the O/o The Director, RAC. 05.06.2009
- (d) Receipt of completed Application Form sent by post, by candidates from Andaman & Nicobar Island and Lakshadweep. 15.06.2009

**Date & Time of Test : 6th September, 2009
10.00 hrs. to 13.00 hrs.**

For any query related to SET-2009
Please contact CAPIO at Telefax No - 01123812608