Academic Year 2019-20

Higher Degree (M.E. / M.Pharm. / M.Phil.) Admission Brochure
Admission Brochure for Higher Degree Admission: First Semester 2019-20

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ABOUT BITS PILANI

BITS Pilani is a Deemed to be University, offering on-campus programmes to around 13,000 UG, 800 PG and 1,100 Doctoral students across its campuses in Pilani, Goa, Hyderabad and Dubai. It also offers programmes to nearly 19,000 working professionals through its Work Integrated Learning Programmes. Having pioneered the credit based semester system in technical education in the country, BITS Pilani has a vision to be amongst the top research led Institutes in the country. The Institute has secured more than Rs. 120 crore funding through 445 sponsored projects in the last 5 years. State of the art facilities have been developed to support cutting edge research, led by around 750 faculty and students, leading to over 8100 SCI publications with 77,900 citations and 60 patents being filed till date. BITS Pilani has been recently recognized as an “Institute of Eminence” tag by MHRD. It was ranked 17th in the University category and 5th in the Pharmacy category in 2018 by the National Institutional Ranking Framework (NIRF) released by Ministry of HRD, Govt of India. It is also India’s highest ranked non-Government Institute as declared in various reputed world rankings like QS BRICS, QS Asia, and QS India in 2019. BITS Pilani has recently secured a place in the World top 500 QS Subject Rankings 2019 in Mechanical & Manufacturing, Electrical & Electronics and Computer Science and THE 2019 World top 500 Subject Ranking in Life Sciences where BITS Pilani is among the top 8 from India.

ADMISSION TO HD PROGRAMMES FOR ACADEMIC YEAR 2019 - 2020

BITS Pilani invites applications to its 4 Semester on-campus M.E. / M.Pharm. and 3 Semester M.Phil. Higher Degree (HD) programmes for the year 2019 – 2020. Admissions are open for the following programmes to be offered in the Pilani, Goa and Hyderabad campuses of BITS Pilani:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Programmes</th>
<th>Pilani</th>
<th>Goa</th>
<th>Hyderabad</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E.</td>
<td>Biotechnology</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Civil (specialization in Infrastructure Engg &amp; Management)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Civil (specialization in Structural Engg)</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Civil (specialization in Transportation Engg)</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication Engineering</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Computer Science</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Design Engineering</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Embedded Systems</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Systems</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Mechanical (specialization in Thermal Engg)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microelectronics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Software Systems</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sanitation Science, Technology and Management</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.Pharm.</td>
<td>M.Pharm. (specialization in Pharmaceutical Chemistry)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M.Pharm. (specialization in Pharmaceutics)</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>M.Phil.</td>
<td>M.Phil. in Liberal Studies</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

✓ programme will be offered only in this/these campuses
Duration: Normally four semesters (for M.E. / M.Pharm.) and 3 Semesters (M.Phil.)

Note: Final list of programs offered is subject to a minimum number of applications for a particular programme.

ELIGIBILITY

A minimum of 60% for M.E. / M.Pharm. and 55% for M.Phil. in the qualifying Degree examination

ADMISSION MODALITY

Admission to all M.E. (except Software systems) and M.Pharm. programmes will be made on the basis of marks obtained in the BITS HD admission test or based on GATE / GPAT score. Admission to M.E. in Software Systems will be through the BITS HD test only. For admission to the M.Phil. programme, shortlisted candidates will be called for a test and interview.

Interested candidates have to apply online ensuring all deadlines are met. While applying online, candidates will be asked to give their preferences to the different programmes offered. In addition, the candidate has to opt for one of the following:

(i) Consideration for admission only on the basis of GATE/GPAT score
    (Scores of GATE 2019 or GATE 2018 or GATE 2017 will be only considered to admissions to M.E. programmes. Similarly scores of GPAT 2019 or GPAT 2018 or GPAT 2017 will only be considered to admissions to M.Pharm. programmes). Candidates must however ensure that their GATE/GPAT scores are valid to be considered for admission. This validity as mentioned on the GATE / GPAT scorecard must be mentioned in the application form.

(ii) Consideration for admission only on the basis of marks obtained in the BITS HD online test

(iii) Consideration for admission based on basis of both GATE/GPAT score and marks obtained in the BITS HD online test
    - Details of programme wise input eligibility criteria is given in Annexure I
    - Details of programme wise eligibility through GATE / GPAT examination is given in Annexure II.
    - Details of BITS HD Test is given in Annexure III

PREPARATION OF MERIT LIST FOR ADMISSIONS:

In the process of making final admission offers to the M.E. / M.Pharm. programmes, two separate merit lists will be prepared for each degree program; one based on GATE/GPAT score, and the other based on Marks obtained in BITS HD test. In each program, 50% of the seats will be filled through GATE/GPAT scores and other 50% by BITS HD test marks. The admission committee will consider a cut-off score in each category, based on the applications received and the seats available. If any seat in one category is not-filled, it will be allocated to the other category. Final decision on this will be taken by the Admission Committee and will be binding to all. Admission to the HD programmes will be on the basis of merit only.

IMPORTANT NOTE

Admissions to the M.E. Software Systems programme will be made only through the BITS HD Test. Details of the Software System BITS HD Test are given in Annexure III. Admissions will be made on the basis of merit position of students in the Software System BITS HD test. There will be no BITS HD test for admission to the M.Phil. programme. For admissions to this programme, shortlisted candidates will be called for a test and interview by the concerned Department based on which final admission to the programme will take place.
FINANCIAL ASSISTANCE

Candidates admitted through GATE / GPAT will be eligible for a tuition fee waiver of Rs. 13,400/- per month over and above the GATE / GPAT scholarship that they will receive. All other students admitted to the HD programme will be eligible for a stipend of Rs. 13,400/- per month. The fee waiver / stipend will be in lieu of 6 - 8 hrs. of work per week.

APPLICATION PROCESS

1. Interested and eligible candidates should apply through the prescribed application form available online at http://www.bitsadmission.com/hd. Hard copy of application form is not required to be sent. However candidates are advised to take a printout of the filled-in form and keep a copy with them for further reference.

2. While filling the application form online, candidates are required to give preferences to programmes which they wish to apply for. Please refer to programme wise eligibility criteria before filling the application form.

3. Candidates who wish to be considered for admission through GATE/GPAT must enter details of GATE/GPAT score, year of examination, All India Rank if applicable and Registration / Roll Number

4. Candidates who wish to write BITS HD Test are to give their preference for three Test centers.
   
   Note: Those who give preference for M.E. Software Systems have to appear in BITS HD test, and GATE/GPAT score has no relevance in deciding the merit position of the candidate.

5. The completed application form along with the prescribed application fee should be submitted online by the prescribed deadline. Detail on modes of Fee Payment is available at the website while applying online.

6. Portal to apply online opens on 18th March 2019.

7. Deadline for submission of the completed application form online is 5.00 P.M. on 30th April 2019.

APPLICATION FEE

• Those who wish to be considered through GATE/GPAT score only: Rs 1000/-
• All others Rs 3150/- (including the fee for BITS HD online test)

Important dates and deadlines:

Portal to apply online open : 18th March 2019

Deadline for submission of completed application form online with prescribed fee : 30th April 2019

Announcement of admission offers to candidates based on GATE / GPAT score (Iteration 1) : 3rd May 2019

Deadline for payment of advance fees by candidates offered admission through GATE / GPAT : 20th May 2019

BITS HD Online Test : 15th & 26th May 2019
Announcement of admission offers to candidates based on BITS HD test and GATE / GPAT (Iteration 2) and shortlisting of candidates for the M.Phil. programme

Deadline for payment of advance fees by candidates offered admission through Iteration 2

Announcement of admission offers to candidates admitted through BITS HD test and GATE / GPAT (Iteration 3)

Deadline for payment of advance fees by candidates offered admission through Iteration 3

Deadline for payment of balance fees by all students offered admission to the HD programme

Announcement of admission offers to candidates admitted through BITS HD test and GATE / GPAT (Iteration 4)

Deadline for payment of fees by students offered admission through Iteration 4

Reporting date for admission in respective campus

Freshman Orientation Programme

Registration

The Institute reserves the right to conduct further iteration/s if necessary.

Candidates shortlisted for the M.Phil. programme will be announced on 3rd June. The test and interview for these candidates will be on 18th July and admission offers will be made on 20th July.

Details of fee structure for 2019-20 and related modes of payment will be made available on www.bitsadmission.com/hd in the coming days. Candidates must look up the website for information pertaining to fees and regular updates pertaining to HD admissions for 2019 – 2020.

A candidate can submit only one application form for Higher Degree admissions. However, if a candidate discovers any mistake in the form submitted by him, there will be an edit option which will be made available before the final deadline for submission, which he/she can make use of.

Only candidates who have paid advance fees as per deadlines mentioned above will be considered further in the admission process.
### PROGRAMME-WISE ELIGIBILITY CRITERIA

<table>
<thead>
<tr>
<th>Programme</th>
<th>Input (Eligibility Criteria)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. Biotechnology</td>
<td>Any integrated First Degree of BITS or its equivalent with adequate preparation in Bio-chemistry and Microbiology</td>
</tr>
<tr>
<td>M.E. Chemical</td>
<td>Integrated First Degree of BITS in the respective discipline or its’ equivalent</td>
</tr>
<tr>
<td>M.E. Civil (specialization in Infrastructure Engg. &amp; Management)</td>
<td></td>
</tr>
<tr>
<td>M.E. Civil (specialization in Structural Engg.)</td>
<td></td>
</tr>
<tr>
<td>M.E. Civil (specialization in Transportation Engg.)</td>
<td></td>
</tr>
<tr>
<td>M.E. Computer Science</td>
<td></td>
</tr>
<tr>
<td>M.E. Mechanical</td>
<td></td>
</tr>
<tr>
<td>M.E. Mechanical with specialization in Thermal Engineering</td>
<td></td>
</tr>
<tr>
<td>M.E. Communication Engineering</td>
<td>Integrated First Degree of BITS in Electrical &amp; Electronics/Electronics &amp; Instrumentation/Electronics &amp; Communication or its equivalent</td>
</tr>
<tr>
<td>M.E. Design Engineering</td>
<td>Integrated First Degree of BITS in Mechanical/Manufacturing Engineering or its equivalent</td>
</tr>
<tr>
<td>M.E. Manufacturing Systems Engineering</td>
<td>Integrated First Degree of BITS in Mechanical/Manufacturing Engineering or its equivalent</td>
</tr>
<tr>
<td>M.E. Embedded Systems</td>
<td>Integrated First Degree of BITS in Electrical &amp; Electronics/ Electronics &amp; Instrumentation/ Electronics &amp; Communication / Computer Science or its’ equivalent</td>
</tr>
<tr>
<td>M.E. Microelectronics</td>
<td>Integrated First Degree of BITS in Electrical &amp; Electronics/ Electronics &amp; Instrumentation/ Electronics &amp; Communication / Computer Science/ Physics or its equivalent</td>
</tr>
<tr>
<td>M.E. Software Systems</td>
<td>Any Integrated First Degree of BITS or its equivalent with specific prior preparation</td>
</tr>
<tr>
<td>M.E. Sanitation Science, Technology and Management</td>
<td>Integrated First Degree of BITS or its equivalent in the areas of Biology, Civil, Chemical Engineering, and Chemistry. Any other M.Sc. or B.E. with adequate preparations may be considered for this programme</td>
</tr>
<tr>
<td>M.Pharm.</td>
<td>Integrated First Degree of BITS in Pharmacy or its equivalent</td>
</tr>
<tr>
<td>Degree</td>
<td>Requirements</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>M.Pharm. (specialization in Pharmaceutical Chemistry)</td>
<td></td>
</tr>
<tr>
<td>M.Pharm. (specialization in Pharmaceutics)</td>
<td></td>
</tr>
</tbody>
</table>
| M.Phil. in Liberal Studies                  | • Integrated First Degree of BITS in any discipline  
• M. A. /M. Sc. in Humanities and Social Sciences  
• Any other M.Sc./M.S.W. degree or its equivalent with the requirement of taking certain additional courses |

**Note:** Students coming with Integrated First Degree of BITS may be considered for admission to any M.E. Programme with the requirement of taking additional courses. The duration in these cases may be more than the normal duration and will be determined on a case by case basis.
**ANNEXURE - 2**

Programme wise Input Eligibility criteria and Eligible GATE/GPAT paper

<table>
<thead>
<tr>
<th>M.E. Programme</th>
<th>Input Eligibility Criteria</th>
<th>Eligible GATE Paper (Code)</th>
</tr>
</thead>
</table>
| **Biotechnology** | Any integrated First Degree of BITS or its equivalent with adequate preparation in Biochemistry and Microbiology | • Biotechnology (BT)  
• Life Sciences (XL) |
| **Chemical** | Integrated First Degree of BITS in the respective discipline or its' equivalent | Chemical Engineering (CH) |
| **M.E. Civil (specialization in Infrastructure Engg. & Management)** | | Civil Engineering (CE) |
| **M.E. Civil (specialization in Structural Engg.)** | Integrated First Degree of BITS in the respective discipline or its' equivalent | Computer Science and Information Technology (CS) |
| **M.E. Civil (specialization in Transportation Engg.)** | | |
| **M.E. Computer Science** | | |
| **M.E. Mechanical** | | |
| **M.E. Mechanical with specialization in Thermal Engineering** | | |
| **M.E. Communication Engineering** | Integrated First Degree of BITS in Electrical & Electronics/Electronics & Instrumentation/Electronics & Communication or its equivalent | • Electronics & Communication Engineering (EC)  
• Electrical & Electronics Engineering (EE),  
• Instrumentation Engineering (IN) |
| **M.E. Design Engineering** | Integrated First Degree of BITS in Mechanical/Manufacturing Engineering or its equivalent | • Mechanical Engineering (ME),  
• Production and Industrial Engineering (PI),  
• Metallurgical Engineering (MT) |
| **M.E. Manufacturing Systems Engineering** | Integrated First Degree of BITS in Mechanical/Manufacturing Engineering or its equivalent | • Mechanical Engineering (ME),  
• Production and Industrial Engineering (PI),  
• Metallurgical Engineering (MT) |
| **M.E. Embedded Systems** | Integrated First Degree of BITS in Electrical & Electronics/Electronics & Instrumentation/ Electronics & Communication/ Computer Science or its’ equivalent | • Electronics & Communication Engineering (EC),  
• Electrical & Electronics Engineering (EE),  
• Instrumentation Engineering (IN)  
• Computer Science and Information Technology (CS) |
| **M.E. Microelectronics** | Integrated First Degree of BITS in Electrical & Electronics/Electronics & Instrumentation/ Electronics & Communication/ Computer Science or its’ equivalent | • Electronics & Communication |
| M.E. Sanitation Science, Technology and Management | Electrical & Electronics/ Electronics & Instrumentation/ Electronics & Communication / Computer Science/ Physics or its equivalent | Engineering (EC), • Electrical & Electronics Engineering (EE), • Instrumentation Engineering (IN) • Computer Science and Information Technology (CS) Physics (PH) |
| M.E. Sanitation Science, Technology and Management | Integrated First Degree of BITS or its equivalent in the areas of Biology, Civil, Chemical Engineering, and Chemistry. Any other M.Sc. or BE with adequate preparations may be considered for this programme | • Agricultural Engineering (AG) • Architecture and Planning (AR) • Biotechnology (BT) • Civil Engineering (CE) • Chemical Engineering (CH) • Chemistry (CY) • Ecology and Evolution (EY) • Engineering Sciences (XE) • Life Sciences (XL) |
| M.Pharm. | Integrated first degree of BITS in Pharmacy or its equivalent | GPAT |
| M.Pharm. (specialization in Pharmaceutical Chemistry) | | |
| M.Pharm. (specialization in Pharmaceutics) | | |
DETAILS OF BITS HD (BITS HIGHER DEGREE) EXAMINATION

The test will be a computer based online test conducted by BITS Pilani at dedicated centers in different cities of India. Computer based online test means the candidate sits in front of a computer and the questions are presented on the computer monitor and the candidate submits the answers through the use of keyboard & mouse. Each computer is connected to a server, which prepares the question set and delivers it to the candidate on the computer. The online tests will be conducted on 15th and 26th May 2019 and the candidates can choose the center to take the test as prescribed in later sections.

A. Details of the Online Test:

Test I: Duration: 45 Minutes. Total No of questions: 30
Test I is compulsory for all students who are applying for any of the Higher Degree programmes of the Institute and will consist of the following sections:

<table>
<thead>
<tr>
<th>Sections</th>
<th>No. of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Mathematics</td>
<td>15</td>
</tr>
<tr>
<td>English Language Skills &amp; Logical Reasoning</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
</tr>
</tbody>
</table>

The course descriptions are available in the syllabus given later in the brochure.

Test II: Duration: 105 Minutes. Total number of questions: 70
Test II is for students applying to all Higher Degree programmes except those who are applying for M.E. in Sanitation Science, Technology and Management and M.E. in Software systems. This paper will attempt to test student’s grasp of the basic subjects of his discipline. The discipline courses of different degree programmes of BITS have been used for constructing the questions. The course descriptions are available in the syllabus given later in the brochure.

Test for Software Systems: Duration: 60 Minutes Total number of questions: 50
This special test for Software Systems is required for only those students who are applying for M.E. Software systems. The course descriptions are available in the syllabus given later in the brochure.

Test for M.E. Sanitation Science, Technology and Management
Duration: 60 Minutes Total number of questions: 50
This special test for Sanitation Science, Technology and Management is required for only those students who are applying for M.E. Sanitation Science Technology and Management. The course descriptions are available in the syllabus given later in the brochure.

For all the above tests, all questions are of objective type (multiple choice questions); each question with four answer choices, only one being the correct choice. Each correct answer fetches 3 marks, while each
incorrect answer has a **penalty of 1 mark**. No marks are awarded or deducted for questions not attempted. While the candidate can skip a question, the computer will not allow the candidate to choose more than one option as the correct answer.

All the questions and instructions of the test will be in English only.
The questions will be selected at random from a large question bank. Different candidates will get different question sets. An expert committee will ensure that the question sets are of comparable difficulty level, content, question type etc. In this matter the decision of the expert committee will be final and binding on the candidate.

**B. Test Center details:**
The planned HD test centers are in the following cities. The final list of centers and the operating days at each center will depend on the number of applicants and their preferences.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>2</td>
<td>Allahabad</td>
</tr>
<tr>
<td>3</td>
<td>Bangalore</td>
</tr>
<tr>
<td>4</td>
<td>Bhopal</td>
</tr>
<tr>
<td>5</td>
<td>Bhubaneswar</td>
</tr>
<tr>
<td>6</td>
<td>Chennai</td>
</tr>
<tr>
<td>7</td>
<td>Coimbatore</td>
</tr>
<tr>
<td>8</td>
<td>Delhi</td>
</tr>
<tr>
<td>9</td>
<td>Ghaziabad</td>
</tr>
<tr>
<td>10</td>
<td>Goa Campus of BITS</td>
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<tr>
<td>11</td>
<td>Gurgaon</td>
</tr>
<tr>
<td>12</td>
<td>Guwahati</td>
</tr>
<tr>
<td>13</td>
<td>Hyderabad Campus of BITS</td>
</tr>
<tr>
<td>14</td>
<td>Hyderabad City</td>
</tr>
<tr>
<td>15</td>
<td>Indore</td>
</tr>
<tr>
<td>16</td>
<td>Jaipur</td>
</tr>
<tr>
<td>17</td>
<td>Jodhpur</td>
</tr>
<tr>
<td>18</td>
<td>Kolkata</td>
</tr>
<tr>
<td>19</td>
<td>Lucknow</td>
</tr>
<tr>
<td>20</td>
<td>Mumbai</td>
</tr>
<tr>
<td>21</td>
<td>Nagpur</td>
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<td>22</td>
<td>Nasik</td>
</tr>
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<td>23</td>
<td>Noida</td>
</tr>
<tr>
<td>24</td>
<td>Patna</td>
</tr>
<tr>
<td>25</td>
<td>Pilani Campus of BITS</td>
</tr>
<tr>
<td>26</td>
<td>Pune</td>
</tr>
</tbody>
</table>
Candidates have to give three preferences of examination center and will be allotted to one of the centers. Candidates will be informed about the test center allotment through BITS admission’s website [http://www.bitsadmission.com](http://www.bitsadmission.com).

Each candidate who registers for the test will be required to download a ‘Hall Ticket’ from the website during 9th May – 14th May 2019. Candidates with a hall ticket will only be allowed inside the test centers. Candidates should bring a pen for the purpose of rough work, signing etc. Blank sheets for rough work will be provided, if required. Candidates can bring a calculator without any network connectivity/programmable feature. Candidates are not allowed to bring any other personal belongings such as mobile phones; ipods or any other electronic gadgets.

All centers are closely monitored for security and candidates’ identity and activities will be recorded using web cameras and/or closed circuit TV cameras. Anyone violating the rules of the test center will not be allowed to continue with the test and will be automatically disqualified. On completion of the test, the computer will display to each candidate his/her score obtained.

### B. IMPORTANT DATES AND DEADLINES (RELATED TO BITS HD TEST)

<table>
<thead>
<tr>
<th>Test Center allotment to Candidates</th>
<th>2nd May 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slot and Date booking</td>
<td>4th – 7th May 2019</td>
</tr>
<tr>
<td>Candidates to download Hall tickets</td>
<td>9th May – 14th May 2019</td>
</tr>
<tr>
<td>Online HD Test</td>
<td>15th and 26th May 2019</td>
</tr>
</tbody>
</table>

**Important Notes**

i. The Online tests are generated from a large question bank and different candidates will get different question sets. An expert committee will ensure that the question sets are of comparable difficulty level, content, question type etc. In this matter, the decision of the expert committee will be final and binding on the candidates.

ii. The test assumes that the candidates have basic familiarity with use of computers like use of keyboard and mouse operation. It is the responsibility of the candidates to acquire these skills before appearing in the test and the Institute will not be responsible for the same.

iii. The Institute is planning to operate Test centers in different cities other than Pilani, Goa and Hyderabad as previously stated. The final list of centers will be announced to candidates through the BITS website. The Institute cannot guarantee that test centers will be set up in all these centers. Further, the Institute reserves the right to cancel any test center if such situation arises. In such cases, those candidates allotted to these centers will be accommodated in alternate test centers including Pilani, Goa and Hyderabad.

iv. The candidates must fully obey the rules of the test centers; otherwise he/she will be automatically debarred from the test.

v. In all matters in the conduct of test, the decision of the Vice Chancellor of BITS will be final.
vi. All disputes pertaining to the Higher Degree admission shall fall within the jurisdiction of Pilani city.

vii. All notices regarding test, shortlisting etc. will be put up only on BITS Pilani admission website. Candidates should regularly check the same and related updates.

viii. If you are applying through GATE/GPAT route, you should upload a self-attested GATE/GPAT score card (scanned copy) while applying online.

Queries related to BITSHD-2019 will only be answered through the following numbers and email IDs’ of admission offices at Pilani, Goa and Hyderabad campuses:

<table>
<thead>
<tr>
<th></th>
<th>Pilani Campus</th>
<th>K K Birla Goa Campus</th>
<th>Hyderabad Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Telephone</strong></td>
<td>01596-242205 10.00 am till 5.00 pm on all working days</td>
<td>0832-2580126 10.00 am to 5.00 pm on all working days</td>
<td>040-66303830 10.00 am till 5.00 pm on all working days</td>
</tr>
<tr>
<td><strong>Email ID</strong></td>
<td><a href="mailto:admnoc@pilani.bits-pilani.ac.in">admnoc@pilani.bits-pilani.ac.in</a></td>
<td><a href="mailto:admissions.office@goa.bits-pilani.ac.in">admissions.office@goa.bits-pilani.ac.in</a></td>
<td><a href="mailto:admissions@hyderabad.bits-pilani.ac.in">admissions@hyderabad.bits-pilani.ac.in</a></td>
</tr>
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</table>

### SYLLABUS FOR TEST I

#### Core Mathematics

**Calculus:** Functions and graphs; limit and continuity; Applications of Derivatives, Applications of Definite Integrals, Convergence of Infinite sequences and series, Maclaurin and Taylor series. Functions of several variables, Limits and Continuity in Higher Dimensions, Partial derivatives, The chain rule, Directional Derivatives and Gradient vectors, Tangent planes and Normal lines, Extreme values and saddle points, Double Integrals, Triple Integrals, Line and surface Integrals, Conservative fields, Curl and divergence, Theorems of Green, Gauss and Stokes.

**Linear Algebra:** Matrix Algebra, Row reduction method, Rank and inverse of a matrix, System of linear equations, Vector space; basis and dimension; linear transformation; range and kernel of a linear transformation; Eigenvalues and eigenvectors. 

**Complex Variables:** Analytic functions, Cauchy’s theorems; Cauchy’s integral formula, Taylor Series and Laurent Series; Calculus of residues and applications.

**Probability and Statistics:** Sample space and events, Conditional probability and independence; Random variables and probability distributions; Independent random variables; Mathematical expectation; mean and variance; Geometric, Binomial, Poisson’s, Exponential, Gamma and Normal distributions; sum of independent random variables; law of large numbers; Central limit theorem, Marginal and conditional distributions; Sampling distribution, Point estimation, Statistical intervals based on a Single sample, Tests of hypotheses based on a single sample, test for mean using normal and Students t-distribution; Correlation and linear regression.

**Differential Equations:** First order differential equations (linear and nonlinear), higher order linear differential equations with constant coefficient, method of variation of parameters, Cauchy-Euler’s equation, Fourier Series, Laplace Transform, Initial and boundary value problems, Partial differential equations, Method of separation of variables.

**Numerical Methods:** Solution of nonlinear algebraic equations: Newton’s method, Secant method, Fixed
point iteration method, method of false position, Solution of system of linear equations: Direct methods & Iterative methods, LU decomposition, Integration by Trapezoidal and Simpson’s rule.

### English Language and Logical Reasoning

#### (a) English Language

This test is designed to assess the test takers’ general proficiency in the use of English language as a means of self-expression in real life situations and specifically to test the test takers’ knowledge of basic grammar, their vocabulary, their ability to read fast and comprehend, and also their ability to apply the elements of effective writing.

<table>
<thead>
<tr>
<th>1. Grammar</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>1.1 Agreement, Time and Tense, Parallel construction, Relative pronouns</td>
<td></td>
</tr>
<tr>
<td>1.2 Determiners, Prepositions, Modals, Adjectives</td>
<td></td>
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<tr>
<td>1.3 Voice, Transformation</td>
<td></td>
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<tr>
<td>1.4 Question tags, Phrasal verbs</td>
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</table>

<table>
<thead>
<tr>
<th>2. Vocabulary</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Synonyms, Antonyms, Odd Word, One Word, Jumbled letters, Homophones, Spelling</td>
<td></td>
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<tr>
<td>2.2 Contextual meaning.</td>
<td></td>
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<tr>
<td>2.3 Analogy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Reading Comprehension</th>
<th></th>
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<tbody>
<tr>
<td>3.1 Content/ideas</td>
<td></td>
</tr>
<tr>
<td>3.2 Vocabulary</td>
<td></td>
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<tr>
<td>3.3 Referents</td>
<td></td>
</tr>
<tr>
<td>3.4 Idioms/Phrases</td>
<td></td>
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<tr>
<td>3.5 Reconstruction (rewording)</td>
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</table>

<table>
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<tr>
<th>4. Composition</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>4.1 Rearrangement</td>
<td></td>
</tr>
<tr>
<td>4.2 Paragraph Unity</td>
<td></td>
</tr>
<tr>
<td>4.3 Linkers/Connectives</td>
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</table>

#### (b) Logical Reasoning

The test is given to the candidates to judge their power of reasoning spread in verbal and nonverbal areas. The candidates should be able to think logically so that they perceive the data accurately, understand the relationships correctly, figure out the missing numbers or words, and to apply rules to new and different contexts. These indicators are measured through performance on such tasks as detecting missing links, following directions, classifying words, establishing sequences, and completing analogies.

<table>
<thead>
<tr>
<th>5. Verbal Reasoning</th>
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<tbody>
<tr>
<td>5.1 Analogy</td>
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</table>
Analogy means correspondence. In the questions based on analogy, a particular relationship is given and another similar relationship has to be identified from the alternatives provided.

5.2 Classification

Classification means to assort the items of a given group on the basis of certain common quality they possess and then spot the odd option out.

5.3 Series Completion

Here series of numbers or letters are given and one is asked to either complete the series or find out the wrong part in the series.

5.4 Logical Deduction – Reading Passage

Here a brief passage is given and based on the passage the candidate is required to identify the correct or incorrect logical conclusions.

5.5 Chart Logic

Here a chart or a table is given that is partially filled in and asks to complete it in accordance with the information given either in the chart/table or in the question.

6. Nonverbal Reasoning

6.1 Pattern Perception

Here a certain pattern is given and generally a quarter is left blank. The candidate is required to identify the correct quarter from the given four alternatives.

6.2 Figure Formation and Analysis

The candidate is required to analyze and form a figure from various given parts.

6.3 Paper Cutting

It involves the analysis of a pattern that is formed when a folded piece of paper is cut into a definite design.

6.4 Figure Matrix

In this more than one set of figures is given in the form of a matrix, all of them following the same rule. The candidate is required to follow the rule and identify the missing figure.

6.5 Rule Detection

Here a particular rule is given and it is required to select from the given sets of figures, a set of figures, which obeys the rule and forms the correct series.

SYLLABUS FOR TEST II

Chemical Engineering

Chemical Process Calculations

**Chemical Process Calculations:** Units and Dimensions, Chemical Equation and Stoichiometry, Thermodynamic properties of Gases, Vapors, Liquids and Solids, Steady and unsteady state mass and energy balances, Phase Equilibria (multiphase, multicomponent), reacting and non-reacting systems, recycle, bypass and purge calculations, Combustion Calculations.

**Reference books:**
### Fluid Mechanics

Fundamental Concepts and Fluid Statics, basic concept of Newtonian and non-Newtonian fluids, head losses, velocity and pressure drop calculation. Integral and Differential Analyses for Fluid Motion, Internal and External Fluid Flow and Flow through Packed & fluidized beds, Dimensional Analysis, flow meters, pumps and compressors.

**Reference books:**


### Chemical Engineering Thermodynamics

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

**Reference books:**


### Mass Transfer

Molecular diffusion and mass transfer coefficients, Interphase mass transfer, heat and mass transfer analogies, design and operation of equipment for distillation, absorption, Adsorption, leaching, extraction, drying and adsorption, humidification, crystallization.

**Reference books:**


### Heat Transfer

Steady and Unsteady state heat conduction, Natural & Forced convection, Radiation, Condensation, boiling and evaporation, Heat Exchangers.

**Reference books:**


### Mechanical Operations

Properties and Handling of Particulate Solids, Mechanical Separations, particle size distribution, size
reduction operation, operation of centrifuge and cyclones, filtration, agitation and mixing.

**Reference books:**


### Chemical Reaction Engineering

Mole balances and reactor sizing, Rate laws and stoichiometry, Isothermal reactor design for single and multiple reactions, Analysis of laboratory reactor data, and reaction mechanisms for nonelementary reactions, Non isothermal reactor design, Heterogeneous reactors, Non Ideal reactors.

**Reference books:**


### Chemical Process Technology

Inorganic chemical industries (sulphuric acid, phosphoric acid); Fertilizer industries (Ammonia, Urea, SSP, TSP); Natural product industries (Pulp & paper, Sugar, Oils & fats); Petroleum Refining and Petrochemicals; Polymerization industries (polyethylene, polypropylene, polyester synthetic fibers, PVC).

**Reference Books:**


### Plant Design and Economics

Principles of process economics, depreciation calculation, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as evaporator, heat exchangers, multistage contactors.

**Reference books:**


### Process Dynamics and Control

Dynamic process modeling, Laplace transform, transfer functions, analysis of the dynamic behavior of chemical processes, Analysis and design aspect of feedback controllers (P, PI and PID), controller tuning, advanced control systems, measurement of process variables; sensors, transducers and their dynamics.

**Reference Books:**

### Civil Engineering

#### Mechanics and Strength of Materials


**Reference books:**


#### Analysis of Structures

Statics of Structures and Degree of Indeterminacy, Analysis of Determinate and Indeterminate Structures (trusses, beams, frames, cables and arches), Deflection of beams and Frames, Influence lines and its Applications, Introduction to Matrix Methods of Structural Analysis.

**Reference books:**

- Structural Analysis by R.C. Hibbler, Pearson, India.

#### Design of Concrete Structures


**Reference books:**

- Design of Concrete Structures, by J. N. Bandyopadhyay, Prentice-Hall of India, New Delhi.

#### Design of Steel Structures (Limit State Design)

Steel Design Specifications and Connections, eccentric and moment connections, Design of Tension and Compression Members, Design of beams and plate girders, Introduction to plastic analysis and design.

**Reference books:**

- Design of Steel Structure by N. Subramaniam, Oxford University Press.

#### Transportation Engineering

Highway alignment; Geometric design of highways: Cross-sectional elements, sight distances, horizontal and vertical alignment designs, Highway Materials - Desirable properties of bitumen, aggregates, soil and bituminous paving mixture design using Marshall’s specifications; Design factors for flexible and rigid pavements, Pavement Design: Factors controlling flexible and rigid pavement designs, design of flexible pavement using IRC: 37, design of rigid pavements using IRC: 58; Overlay design using IRC:81, Traffic Engineering: Traffic studies on flow, speed, travel time - delay and O-D study, EPCU concept, V/C ratios and Level of Service Concepts, traffic control devices - Signal design by IRC and Webster’s methods, Types of intersections and channelization.

**Reference books:**
3. Design Codes: IRC 37, IRC 58, IRC 81, MoRTH Code of Provision

**Surveying**

Chain Survey, Compass Survey & leveling, Theodolite, Tachometric surveying & Traversing, Curve Ranging, Contouring & Plane Tabling, Trigonometric Leveling, Areas and Volumes, Geodetic surveying, Total Stations. Introduction to advanced surveying techniques like DGPS, GIS.

**Reference books:**

**Construction Planning and Technology**

Concrete ingredients- cement, aggregates, chemical and mineral admixtures. Mix design, Fresh and hardened characteristics, Properties, testing and applications of concrete, Masonry materials, Timber, Bituminous materials, Steel, Non-ferrous metals and alloys, Ceramics, Glass, Polymeric materials, Paints, distemper and varnishes, Construction planning and scheduling, Advanced construction techniques.

**Reference books:**
- Gupta R., Construction Planning & Technology’, CBS.

**Soil Mechanics and Foundation Engineering**

Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Indian standard soil classification system; Permeability - one dimensional flow, Darcy’s law; Seepage through soils - two-dimensional flow, flow nets, uplift pressure, piping; Principle of effective stress, capillarity, seepage force and quicksand condition; Compaction in laboratory and field conditions; One-dimensional consolidation, time rate of consolidation; Shear strength of soil using various tests, effective and total shear strength parameters, characteristics of clays and sand. Sub-surface investigations - scope, drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories -Rankine and Coulomb; Stability of slopes - finite and infinite slopes, method of slices and Bishop’s method; Stress distribution in soils - Boussinesq’s and Westergaard’s theories, pressure bulbs; Shallow foundations - Terzaghi’s bearing capacity theory and determination of bearing capacity as per IS:6403, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.

**Reference books:**

**Water and Wastewater Treatment**

Water and wastewater characteristics; Basic unit processes and operations for water treatment; Drinking water standards; Distribution of water; Sewage and sewerage treatment; Primary, secondary and tertiary treatment of wastewater, effluent discharge standards; Sludge disposal.

**Reference books:**


**Water Resource Engineering**

Fluid Mechanics and Hydraulics: Fluid Properties, Fluid pressure and measurement, Hydrostatics, Buoyancy, Fundamentals of fluid flow and Kinematics of fluid in motion, Conservation of mass, momentum and energy, Analysis of flow through pipes, Laminar flow, Study of flow pattern through Orifices and Mouthpieces, Notches and Weirs, Dimensional analysis and similitude, Boundary Layer Theory, Flow past immersed bodies, turbulent flow through conduits; analysis of closed-conduit hydraulic systems including pipes, valves, fittings, and pumps, pipe networks and analysis: Hardy cross method and linear graph method; Open channel hydraulics: uniform and non-uniform flow; analysis and design of hydraulic systems; Analysis of impact of jets; Fluid machinery: theory, performance and application of Pumps and Turbines.

Hydrology: Hydrological Cycle and Budget; Precipitation Measurement and Analysis; Hydrologic Abstractions; Stream Flow analysis and concepts of hydrograph; Hydrologic measurements; Statistical analysis in hydrology; Ground Water hydrology; Flood Routing; Introduction to dams, spillways, diversion head-works and distribution systems, Reservoir planning and multi-purpose reservoirs, hydropower engineering.

**Reference books:**


**Electrical and Electronics Engineering**

**Electrical Sciences**


**Reference book:**


**Electromagnetics**

Maxwell’s equations in free space and in time-varying fields, boundary conditions, wave equation, Poynting vector; Plane waves in dielectric and conducting media, wave reflection, refraction, and polarization, phase and group velocity, skin depth; Transmission lines, Smith chart and its application in impedance matching calculations, Basics of guided wave propagation, Antennas and radiation, antenna parameters, Hertzian dipole, half-wave dipole, loop, helical and horn antennas, antenna arrays, Radio Link and Friis Formula.

**Reference book:**


**Digital electronics**

Number systems & Codes, Boolean algebra & Simplification, Digital Logic Families, Combinational logic

Reference books:

Signals & systems and Digital Signal Processing


Reference books:

Electrical machines


Control system and power electronics

Mathematical model of physical systems: Differential equations, Block diagram, signal flow graph, transfer function, feedback characteristics of control systems, control systems components, Time response analysis, stability, Root locus concepts, frequency response (Bode plots, Polar plots, Nyquist plots), state space analysis and compensation concepts. Line frequency Uncontrolled/Controlled AC-DC Converter (Rectifier); DC-DC Switch-Mode Converters; Switch-Mode DC-AC Converters (Inverters).

Power systems

Power system concepts, per unit system, Transmission line parameters and modeling, Characteristics and performance of lines, Load flow studies, Optimal system operation, Automatic Generation and voltage Control, Power system fault analysis, Power Systems stability.

Analog electronics

Operational amplifier basics, ideal and practical Op-amp configurations, special purpose linear Op-amp circuits: instrumentation amplifiers, isolation, programmable, negative feedback amplifiers etc., Active filters, IC filters; non-linear operational amplifier circuits, analog multipliers, precision and wave shaping
circuits, comparators and Schmitt triggers and applications, Signal generators: sinusoidal and non-sinusoidal oscillators, integrated circuits timers, function generators, PLL, Voltage Regulators; voltage regulator IC, switched capacitor voltage converters, switching regulators, Power amplifiers and output stage circuits, IC power amplifiers, high frequency amplifiers, tuned amplifiers.

Reference books:

Electronic devices and microelectronics circuits
Semiconductor materials and their properties, Carrier transport and excess carriers in semiconductors; Single p-n junction devices- rectifier, Zener diodes, switching diodes, microwave diodes, opto-electronic devices, Bipolar junction transistors; JFET; MOSFET; MOS and CMOS devices; Basic device fabrication steps and techniques and introduction to ICs. Basic single and two stage transistor BJT and MOSFET amplifier; current mirrors and current sources; active load biasing in integrated circuits, Voltage sources and voltage references, differential and multistage amplifiers with and without feedback; frequency response and frequency compensation, Operational amplifiers-2 stage, stability analysis and compensation techniques.

Reference books:

Microprocessor
Introduction to Intel 80x86 processor ISA (8086-80486), Assembly programming, Programmers model of processor, processor architecture; Instruction set, modular assembly programming using subroutines, macros etc. Timing diagrams, Concept of interrupts: hardware & software interrupts, Interrupt handling techniques, Interrupt controllers, Types of Memory & memory interfacing, Programmable Peripheral devices and I/O Interfacing, DMA controller and its interfacing, Serial Interface – PCI Buses, RISC Vs CISC, Cache Memory Organization, Concept of multicore microprocessors, Design of processor based system.

Reference books:
Douglas V Hall, Microprocessor and Interfacing, TMH, Second Edition.

Communication systems

Reference Books:

**Telecom switching**


**Reference Books:**


**Mechanical Engineering**

**Production Techniques**

Metal casting, Metal forming, powder metallurgy, plastic forming and molding, Metal joining, Metrology, metal cutting theory, machining processes, welding processes and Non-conventional manufacturing processes.

**Reference books:**


**Materials Science and Engineering**

Introduction, Structure of Materials (Metal and Ceramics), Dislocations, heat treatment of steel and strengthening Mechanisms of Metals, Phase diagrams, Iron-carbide phase diagram, Phase transformation in Metals, Mechanical and thermal properties of Metals, Polymers (Structure, processes and properties) and introduction to non-destructive testing.

**Reference books:**


**Production Planning and Control**

Forecasting and product planning, Process planning, job design and work measurements, Facilities location and layout, Capacity planning, aggregate planning and scheduling, Inventory and quality control.
**Reference books:**

**Design of Machine Elements**
Criteria for static failure and fatigue failure, design of screws and bolted joints, design of welded joints and riveted joints, Mechanical springs, Design of rolling element bearings, journal bearings and hydrodynamic lubrication, Design of gears, clutches, brakes, couplings, flat and V-belt drives, Computer aided design, and geometric modeling of mechanical parts.
Reference books:

**Kinematics & Dynamics of Machines and Vibrations**
Basics of mechanisms, inversions, Velocity and acceleration analysis, Instantaneous centres, transmission angle, Principle of virtual work, D'Alembert’s principle, Kinetic Modeling, kinetics of mechanism (Four-bar mechanisms) and synthesis of cam – follower motion, Flywheels, governors, gyroscope and balancing, Free and forced vibration, Multi-degree of freedom (two dof) free and forced vibrations, mode shapes, approximate methods of solutions.
Reference books:

**Mechanics of Solids**
Fundamental principle of mechanics, Introduction to mechanics of deformable bodies, slender members, energy Methods, Stress and strain: stress-strain-temperature relations, Symmetric and asymmetric bending, torsion, Curved beams and thick shells, Buckling.
Reference books:

**Thermodynamics**
Properties of pure substance, First law of thermodynamics, Second law of thermodynamics, Entropy, Irreversibility, energy and thermodynamic relations.
Reference books:

**Applied Thermodynamics**
Air standard cycles, gas power cycles, I.C. engines, Vapour compression and absorption cycle, Psychrometrics and air conditioning, Vapour power cycles, boilers, its mountings and accessories, steam turbines, gas turbines, compressors.
### Reference books:

### Fluid Mechanics and Machines
Fluid statics, Conservation laws, Viscous and inviscid flow analysis, Dimensional analysis, Analysis of fluid machines.

**Reference books:**

### Heat Transfer
Conduction: steady state and unsteady state heat conduction, Convection: analytical and empirical relations for forced and free convection heat transfer, condensation and boiling, Radiation heat transfer: basic laws, shape factor, radiation heat exchange between surfaces, Heat exchanger: analysis and design, Mass transfer: diffusion and convective mass transfer.

**Reference books:**

### Pharmacy

**Natural Drugs, Phyto chemistry, Pharmacognosy :**

General Pharmacognosy, traditional systems of medicine, plant nomenclature & classification, macro & micro morphology, standardization parameters; Properties, isolation techniques, tests and functions of alkaloids, alkaloidal drugs belonging to the classes: tropane, ecgonine, quinoline, iso-quinoline, indole, purine, phenanthrine, diterpene, peptide, stereoidal classes including pseudoalkaloids; Classification, isolation techniques, test for glycosides, glycoside drugs of class: anthraquinone, cardenolide, bufedienolide, saponins; Classification, isolation techniques, tests for volatile oils and fixed oils, volatile oil containing drugs including acyclic, monocyclic, bicyclic and tri cyclic terpenoidal drugs, fixed oils containing saturated, unsaturated fatty acids; Classification, isolation procedures, test for resins, drugs of resin alcohol, acid resin and ester resin classes, classification and tests for gums, prepared gums and naturally occurring gums.

**Reference books:**

### Anatomy Physiology & Hygiene
Anatomy of a generalized cell, cellular transport mechanisms, cell division, body tissue types and functions, their properties and characteristics., Composition and functions of blood, Plasma Proteins, RBC, WBC, platelets- anatomy & functions, hemoglobin and blood groups, blood typing, anatomy and physiology of the heart, blood pressure, ECG and its significance, blood vessels., General aspects of neurology, central, peripheral nervous system ( CNS and PNS), autonomic nervous system, endocrine glands, hormones:- their functions and mechanisms of action., Anatomy of the urinary system, mechanisms of urine production, diseases of the kidney, male, female reproductive systems and related
disorders., Organs of the respiratory system, process of respiration, diseases related to the systems.

Reference books:

<table>
<thead>
<tr>
<th>Pharmaceutical Chemistry (Medicinal Chemistry, Chemistry of Synthetic Drugs and Applied Pharmaceutical Chemistry)</th>
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Reference books:

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<tr>
<th>Pharmaceutical and Instrumental Methods of Analysis</th>
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Reference books:

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<tr>
<th>Pharmacology and Toxicology</th>
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<tr>
<td>Introduction, Scope and principles of basic pharmacology and toxicology, mechanisms of drug action, receptors and drug action, pharmacodynamic parameters affecting drug- receptor interaction, Pharmacokinetics and Pharmacodynamics., Cholinergic drugs, cholinergic blockers, adrenergic drugs and their blockers, ganglionic and neuromuscular blocking agents – their mechanisms action., General and local anesthetics, anxiolytics, sedatives and hypnotics, antipsychotics and antidepressants, narcotic and non-narcotic drugs, NSAID’s, CNS stimulants anti-convulsants, anti-parkinsonics agents, their mechanisms., Cardiotonics, antiinflammation, diuretics, anti arrhythmic, drugs for blood disorders – their mechanisms., Principles of Chemotherapy, classification of chemotherapeutic agents, folate antagonists, protein, cell wall synthesis inhibitors, quinolone antibiotics, drugs for UTI, antifungal, antiviral, antitubercular, anthelmintics, antimoebics, anti-cancer drugs.</td>
</tr>
</tbody>
</table>

Reference books:
**Pharmaceutical Microbiology and Biochemistry**

Introduction and classification of microbes, bacteria, virus, fungi, protozoa – physiology and cellular function, infections and immunity, microbials in antibiotic and vaccine preparations., Nutritional requirements and cultivation of microbes, culture media types, physical and chemical methods of microbial control, staining techniques, sterility testing and their validation, sterilization methods and applications., Microbial mechanisms of human pathogenicity, diseases of the skin, CNS, GIT, Respiratory Tract, immune system disorders, antimicrobial drugs and their evaluation., Carbohydrates Lipids, Proteins, Nucleic acids: their structures, biosynthesis, biochemical energetic functions, clinical pathology, deficiency disorders., Enzymes and their regulation; classification, structures, kinetics, inhibition mechanisms, applications.

**Reference books:**


**Forensic Pharmacy and Quality Control Management**


**Reference books:**


**Industrial And Physical Pharmacy**


**Reference books:**


**Pharmaceutical Formulations and Biopharmaceutics**

Pre-formulation studies, Physicochemical properties of drugs and their impact on design of drug delivery systems, classification of dosage forms; Design, Preparation, Evaluation of Pharmaceutical Dosage Forms: Tablets, Solutions, Capsules Micro-encapsulation techniques; Design, Preparation and Evaluation of Novel Drug Delivery Systems such as : Sustained Release, Controlled Release, Transdermal and Transmucosal, Ocular., Parenteral Products: Sterilization methodology, calculations,
evaluation and preparation., Biopharmaceutics: ADME characteristics of drug and their importance in disease conditions, Pharmacokinetic drug interactions, bio-equivalence and bio-availability studies, Prodrugs.

**Reference books:**

**Dispensing Pharmacy**


**Reference books:**

**Computer Science**

**Discrete Mathematics**

Principles of Counting, Recurrence Relations, Sets, Functions, Relations, Propositional Logic and Predicate Logic, Strings and Languages.

**Reference books:**

**Theory of Computation**

Regular Languages, Regular Expressions, Finite Automata (deterministic and non-deterministic), Grammar, Context Free Grammar, Context Free Languages, Push Down Automata (deterministic and non-deterministic), Proving languages to be regular vs. not-regular and context free vs. not-context free, Turing Machines, Universal Turing Machine, Recursive and Recursively Enumerable Languages, Decidability and Un-decidability.

**Reference books:**

**Data Structures & Algorithms**


**Reference Books:**
### Design & Analysis of Algorithms

Algorithm Design Techniques: Top-Down Design (Divide-and-Conquer, Greedy); Bottom-Up Design (Dynamic Programming); Randomization.


Handling Hard Problems: Search – Backtracking, Branch-and-Bound; Introduction to Approximation Algorithms.

**Reference Books:**

### Digital Electronics and Microprocessors


**Reference books:**

### Operating Systems


**Reference books:**

### Computer Organization and Architecture


**Reference books:**

### Computer Networks

Concept of autonomous computing nodes in Computer Networks, Concept of Services, Interfaces & Protocols in Network Architectures; Classification of Networks: LAN MAN, WAN, SAN, PAN, Network Topologies: Bus, Star, Ring, Tree etc., The IEEE 802 Workgroup and select standards: IEEE 802.1, IEEE 802.2, IEEE 802.3 (& Variants): Ethernet, Error Control, Flow Control, Bridges, Basics of Wi-Fi & IEEE

#### Reference Books:


### Database Systems


#### Reference books:


### Compiler Construction


#### Reference books:


### Instrumentation

### Electrical Sciences

(BJT’s), JFET’s and MOSFET, Ideal operational amplifiers configuration, Magnetic Circuits.

**Reference book:**

**Analog Electronics**

Operational amplifier basics, ideal and practical Op-amp configurations, special purpose linear Op-amp circuits: instrumentation amplifiers, isolation, programmable, negative feedback amplifiers etc., Active filters, IC filters; non-linear operational amplifier circuits, analog multipliers, precision and wave shaping circuits, comparators and Schmitt triggers and applications, Signal generators: sinusoidal and non-sinusoidal oscillators, integrated circuits timers, function generators, PLL, Voltage Regulators; voltage regulator IC, switched capacitor voltage converters, switching regulators, Power amplifiers and output stage circuits, IC power amplifiers, high frequency amplifiers, tuned amplifiers.

**Reference books:**

**Digital Electronics**

Number systems & Codes, Boolean algebra & Simplification, Digital Logic Families, Combinational logic Design – Decoders, Encoders, MUX, DeMUX, Arithmetic Circuits, Sequential Logic design - Flip-flops, State machines, ASM, Counters & Registers, PLDs & FPGAs & Computer Organization.

**Reference books:**

**Microprocessors**

Introduction to Intel 80x86 processor ISA (8086-80486), Assembly programming, Programmers model of processor, processor architecture; Instruction set, modular assembly programming using subroutines, macros etc. Timing diagrams, Concept of interrupts: hardware & software interrupts, Interrupt handling techniques, Interrupt controllers, Types of Memory & memory interfacing, Programmable Peripheral devices and I/O Interfacing, DMA controller and its interfacing, Serial Interface – PCI Buses, RISC Vs CISC, Cache Memory Organization, Concept of multicore microprocessors, Design of processor based system.

**Reference books:**
Douglas V Hall, Microprocessor and Interfacing, TMH, Second Edition.

**Signals & systems and Digital Signal Processing**


**Reference books:**

## Electronic devices and microelectronics circuits

Semiconductor materials and their properties, Carrier transport and excess carriers in semiconductors; Single p-n junction devices- rectifier, Zener diodes, switching diodes, microwave diodes, optoelectronic devices, Bipolar junction transistors; JFET; MOSFET; MOS and CMOS devices; Basic device fabrication steps and techniques and introduction to ICs . Basic single and two stage transistor BJT and MOSFET amplifier; current mirrors and current sources; active load biasing in integrated circuits, Voltage sources and voltage references, differential and multistage amplifiers with and without feedback; frequency response and frequency compensation, Operational amplifiers-2 stage, stability analysis and compensation techniques.

### Reference books:

## Control Systems and Power Electronics

Mathematical model of physical systems: Differential equations, Block diagram, signal flow graph, transfer function, feedback characteristics of control systems, control systems components, Time response analysis, stability, Root locus concepts, frequency response (Bode plots, Polar plots, Nyquist plots), state space analysis and compensation concepts. Line frequency Uncontrolled/Controlled AC-DC Converter (Rectifier); DC-DC Switch- Mode Converters; Switch- Mode DC-AC Converters (Inverters).

## Industrial Instrumentation & Control

Elements of process control loop, mathematical modeling, dynamic closed loop characteristics, Controller principles & tuning, DDC loop, Hydraulic, Pneumatic, Electronic controller, Complex multivariable control schemes, final control elements, PLCs, DCS, SCADA, AI techniques: Expert system, ANN, Fuzzy Logic.

### Reference books:
- Stephanopulos George, “Chemical process controls.
- Computer based industrial control by Krishan Kant, Prentice Hall of India

## Transducers & Measurement Techniques

Generalized measurement system, functional elements, Static and dynamic characteristics, Resistive, inductive, capacitive, piezoelectric, Hall effect, photoelectric, fiber optic transducer, MEMS based transducers, Measurement of Motion, pressure, flow, temperature level, viscosity, pH, humidity, vibration, Signal conducting techniques using op-amps, instrumentation amplifier, bridges, carrier amplifier, chopper amplifier, charge amplifier and Isolation amplifier, Data converter, filters, Data acquisition system, inverse transducers & feedback measurement systems.

### Reference books:
- Measurement Systems, application and design by E.O Doebelin and Dhanesh N. Manik, Tata McGraw-Hill.

## Electronic Instruments & Instrumentation Technology
Electronic indicating, display, Recording & Analysis instruments, Signal generators, Frequency synthesizers, Counters, Grounding and Shielding techniques, Instrumentation in hazardous areas, Industrial data communication.

Reference books:
Electronic Instruments and Instrumentation Technology by M.M.S. Anand, Prentice Hall of India.

### Biological Sciences

#### Genetics

Laws of inheritance and genetic interaction, Genetic mapping in Virus, Bacteria, & Eukaryotes, Gene expression in prokaryotes and eukaryotes, Control of gene expression in prokaryotes eukaryotes and Viruses, Population and evolutionary genetics.

Reference books:

#### Molecular Technique

Restriction endonucleases, Vectors and cloning, Blotting technique, PCR, Sequencing

Reference books:

#### Biological Chemistry

Chemistry of Biomolecules, Enzymes, Vitamins & Coenzymes, Bioenergetics and biological oxidation, Metabolism of Biomolecules, Photosynthesis

Reference books:

#### Microbiology

Fundamentals of Microbiology, A survey of the microbial world, Host-Microbe interaction, Microbes and Human disease, Environmental and applied microbiology

Reference books:

#### Ecology

Abiotic factors, Ecosystem ecology and energy flow, Community ecology and population ecology, Regional Ecology (Terrestrial and Aquatic), Regional Ecology (Terrestrial and Aquatic)

Reference books:

#### Plant Physiology

Transport and translocation of water and solutes, Essential elements and their function, Plant development and PGRs, Ascent of sap and translocation in phloem, Movement in plants
<table>
<thead>
<tr>
<th>Reference books:</th>
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<tr>
<td>Plant physiology, 3rd edition by Salisbury &amp; Ross - CBS Publisher and Distributor.</td>
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</table>

### Biophysics

Chemical properties of basic unit of life, energy forces, bonds., Conformation of Biomolecules, Biological membranes and Biomechaniques, Physiochemical techniques to study biomolecules, X-ray crystallography, NMR, molecular modeling.

**Reference books:**

Biophysical chemistry by Cantor and Schimmel. Biophysics by Rodney Cotteril.

### Cell and Developmental Biology

Preview of cell, cellular membranous systems, Transport, Mitochondria, Chloroplast, energy transducing, organelle, Golgi, Nucleus, Cytoskeletal network, Cell growth & proliferation, Cell Immunity, Morphogenesis and cell differentiation, Organogenesis, germ cells and sex, Stem cells.

**Reference books:**

Cell and Molecular Biology-Philip Sheeler & Donald E. Bianchi. 3rd edition, John Wiley Publication.


### Animal physiology

Digestive and Respiratory system, Circulatory system, Excretory system, Nervous and Endocrine system, Body Immune system

**Reference books:**


### Bio statistics and Introduction to Bioinformatics

Introduction to genomic & Proteomics, Human Genome and other sequencing projects, Biological databases and data mining, sequence similarity search and sequence alignment, Protein structure prediction and structure analysis, Phylogenetic analysis, use of software packages in Bioinformatics, Probability and Statistics.

**Reference Books:**

Introduction to Bioinformatics “By Arther M Lesk, Oxford,2003(TB-1)

Bioinformatics Genome and sequence Analysis” by David W Mount, CSHL Press

### Chemistry

#### Chemical Kinetics

Integrated rate laws for simple and complex reactions. Integrated rate laws in terms of properties dependent on concentrations of reactants and/or products. Effect of temperature on reaction rates, Theories of reaction rates: Collision theory and transition state theory, Rate laws and reaction mechanism. Unimolecular, bimolecular and tri-molecular reactions. RRK theory of unimolecular reaction, Reactions in solution. Reactions in excited state. Fast reaction kinetics, Homogeneous and heterogeneous catalysis

**Reference books:**

### Chemical Thermodynamics

Concept and laws of thermodynamic, Thermodynamics of gases, Thermodynamics of non-ideal and electrolyte solutions, Statistical thermodynamics, Non-equilibrium thermodynamics

**Reference books:**
- Donald A. McQuarrie & J. D. Simon, Molecular Thermodynamics Viva Book Pvt Ltd., New Delhi, 2004
- R. C Srivastava, S K Saha, A K Jain, Thermodynamics, 2004

### Quantum chemistry and atomic and molecular structure

Mathematical and Physical Foundations of Quantum Chemistry, Simple potential problems in one, two and three dimension including particle in a box, harmonic oscillator, potential barrier, rigid rotator hydrogen atom, He-atom, effective nuclear charge, Slater orbitals, electron spin, Solution of Hartree-Fock equation for He-atom, self-consistent field, Two electron system, Slater determinants, Hartree-Fock method, Approximation methods, variation, perturbation theory angular momentum, Atomic structure, Molecular structure,

**Reference books :**

### Structure and Reactivity of Organic Compounds

Aliphatic & Aromatic Nucleophilic Substitutions, Aromatic Electrophilic Substitution, Addition to carbon-carbon multiple and carbon-hetero multiple bonds, Eliminations, Orbital symmetry in organic reactions

**Reference books:**

### Instrumental methods of analysis

Magnetic Resonance Spectroscopy (¹H NMR, ¹³C NMR, EPR), IR Spectroscopy, Mass Spectrometry, Ultraviolet and visible spectroscopy, fluorescence spectroscopy, chromatography and other separation techniques, Structure Resolution by combination of techniques.

**Reference books :**

### Bonding in inorganic compounds

Point Groups and Molecular Symmetry, Character Tables and applications of point group symmetry, Ionic bond; Polarization, Covalent bond; VB and MO theories, Coordination Compounds bonding and spectra.
### Reference books:

### Chemical experimentation

- Acid base titrations, Complexometric titrations, Synthesis of organic compounds and functional group identification, Study of kinetics of chemical reactions, Determination of partition function, Adsorption isotherm, Synthesis and characterization of nanomaterials, Qualitative analysis of salts/mixture of salts

### Reference books:
- Vogel’s textbook of practical organic chemistry 5th edition
- Vogel’s textbook of quantitative inorganic analysis
- Vogel’s qualitative inorganic analysis, 7th edition

### Synthetic organic Chemistry

- One Group C-X Disconnections, Two Group C-X Disconnections, One Group C-C Disconnections, Two Group C-C Disconnections, Ring Synthesis and Synthesis of Heterocyclic Compounds.

### Reference books:

### Basic organic and inorganic chemistry

- Stereochemistry (Isomerism, chirality, origin of optical activity, stereochemistry of cyclic compounds, resolution), Conformations (Rotation around sigma bonds, conformational analysis of butane, cyclohexane, and substituted cyclohexanes.), Name reactions (Diels Alder reaction; Friedel-Crafts(acylation and alkylation) reaction; Clemmensen reduction; Wittig reaction; Claisen condensation; Hofmann and Cope eliminations), Co-ordination chemistry, Chemistry of main group elements.

### Reference books:

### Chemistry of Organic Compounds

- Carboxylic acid and carboxylic acid derivatives, Chemistry of aliphatic and aromatic amines, Structure, property and reactions of five and six membered heterocyclic compounds containing O, N and S., Organometallic compounds in organic synthesis: Organolithium, Organomagnesium, Organozinc and Organocopper, Carbohydrates

### Reference books:
## Economics

### Principles of Economics
- Elements of Market Economy, Demand, Supply, Elasticity, Marginal Utility & Indifference Curve Analysis, Consumer Behavior, Analysis of Production and Cost Analysis, Markets, Basics of Macroeconomics, GDP and Components of GDP, Role of Money, Banking and Credit Creation, Economics of Public Goods

**Reference books:**

### Fundamentals of Finance & Accounting
- Basics of Accounting, Financial Statements and Analysis, Financial Ratios, Introduction to Securities, markets and analysis, Banking System, RBI, Non-bank financial intermediaries, Markets for Future, Options & Derivatives; Foreign Exchange Markets

**Reference books:**

### Microeconomics

**Reference books:**

### Macroeconomics

**Reference books:**

### Econometrics

**Reference books:**
- Dougherty, Christopher Intro to Econometrics OUP, 4th ed., 2011

### Money Banking & Financial Markets
- Money and its Functions; Money Markets; Foreign Exchange Markets; Financial Markets; Financial Derivatives; the Banking Firm; Non-banking Financial Institutions; Indian Banking; Monetary Transmission Mechanisms; Money and Inflation; Theory of Rational Expectations; Central banking: Determinants of the Money Supply; Tools, Goals and Targets of Monetary Policy; International Monetary and Financial System. IMF

**Reference books:**
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<tr>
<td>• Agarwala and Singh (eds.) (1992): The Economics of Underdevelopment, Oxford University Press, 1992</td>
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Mathematics

Optimization
Modeling with linear programming, General L. P. Solution, The simplex method, Duality and post optimal analysis, Transportation model and its variants, Goal Programming and Integer linear programming, Non-linear programming Algorithms.

Reference book:
Operations Research: An Introduction by Hamdy A Taha 8/E, Prentice Hall India/Pearson Education

Discrete Mathematics
Logic and methods of proof, Elementary Combinatorics, recurrence relations, Relations and digraphs, orderings, Boolean algebra and Boolean functions.

Reference book:

Elementary Real Analysis
Countable & Uncountable sets, Sequence of real numbers, Limsup & liminf., Metric space, Open & closed sets, limit point, compact sets in Rn, Metric space, Open & closed sets, limit point, compact sets in Rn, Continuous Functions, continuity and compactness, functions, Riemann Integral & Riemann Stieltjes Integral, Sequence & Series of Functions

Reference books:
Principle of Mathematical Analysis by Rudin, Mc-graw hill Publishers

Algebra
Groups, Subgroups, Normal Subgroups, & Quotient Groups, Homomorphisms & Automorphism, Permutation groups, Cauchy Theorem & Sylow Theorem, Rings, Ring Homomorphisms, Ideals & Quotient Rings, Euclidean Rings, Unique Factorization domain, Polynomial Rings.

Reference books:
Topics in Algebra by I.N. Herstein ,Vikas Publishing House Pvt Ltd.

Mathematical Methods

Reference books:

Operations Research

Reference books:
Operations Research Vol.III, EDD Notes; S. Venkateswaran & B. Singh
<table>
<thead>
<tr>
<th>Operations Research: An Introduction by Hamdy A Tah</th>
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<tbody>
<tr>
<td><strong>Graphs and Networks</strong></td>
</tr>
<tr>
<td>Basic concepts of graphs and digraphs behind electrical communication and other networks behind social, economic and empirical structures; connectivity, reachability and vulnerability; trees, tournaments and matroids; planarity; routing and matching problems; representations; various algorithms; applications.</td>
</tr>
<tr>
<td><strong>Reference book:</strong> Narsinhg Deo: Graph theory with applications to engineering &amp; computer science, PHI 1974.</td>
</tr>
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| **Measure and Integration**                          |
| Lebesgue measure, measurable sets, Measurable function, Riemann and Lebesgue integral and its properties, Differentiation, Function of Bounded variations, Lp – spaces, Different modes of convergent |
| **Reference books :** Lebesgue Measure and Integration by P. K. Jain & V. P. Gupta, New Age International Ltd, 1986 |

| **Introduction to Topology**                          |
| Topological spaces; Special topologies, Subspaces; Product spaces & Quotient spaces, Continuity & homeomorphisms, Connectedness & Compactness, Fundamental Groups of Surfaces |

| **Ordinary Differential Equations**                   |
| Existence and uniqueness theorems; properties of linear systems; behaviour of solutions of nth order equations; asymptotic behaviour of linear systems; stability of linear and weakly nonlinear systems; conditions for boundedness and the number of zeros of the nontrivial solutions of second order equations; stability by Liapunov's direct method; autonomous and non autonomous systems. |

| **Numerical Analysis**                                |
| Computer arithmetic and errors, solving nonlinear equations, Solving set of Equations, Interpolation, Numerical differentiation and numerical integration, Numerical solution of ordinary differential equations |
| **Reference books:** Applied Numerical Analysis by Gerald and Wheatley 6/E, Pearson Education |

| **Introduction to Functional Analysis**                |
| Vector spaces, dimension, infinite dimensional vector, faces, Normed linear spaces, Riesz Lemma, Banach spaces, Normed linear spaces lp, C0 ,C[a,c], Continuous linear transformations on normed linear spaces, Inter product spaces, Hilbert spaces, orthogonal sets direct sum, Bessels Inequality, Riesz Representation theorem, uniform bounded ness, principle, open mapping theorem, closed graph theorem. |

| **Differential Geometry**                             |
| Plane curves, Space Curves, Surfaces and Curvatures, First & Second Fundamental Forms, Geodesics |
| **Reference books:** Pressly: Elementary Differential Geometry, Springer – Verlag |

| **Partial Differential Equations**                    |
| Nonlinear equations of first order, Charpits Method, Method of Characteristics; Elliptic, parabolic and hyperbolic partial differential equations of order 2, maximum principle, Duhamels principle, Greens |

| **41** |
function, Laplace transform & fourier transform technique, solutions satisfying given conditions, partial differential equations in engineering & science.

**Reference book:**


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**Physics**

### Modern Physics


**Reference books:**


### Thermodynamics & Properties of Matter


**Reference books:**


### Classical Mechanics

Constraints, Generalized Coordinates, De-Alembert's principle, Lagranges Equations of Motion, Two-body Central force motion, Rigid Body Kinematics, Rigid Body Dynamics, Hamilton's Equations of Motion

**Reference books:**


### Electromagnetic Theory


**Reference books:**


### Quantum Mechanics


**Reference books:**

**Methods of Mathematical Physics**

Vector Analysis, Curvilinear Coordinates, Matrices and Vector Spaces, Functions of Complex Variables, Ordinary Differential Equations, Sturm-Liouville Theory and Special Functions, Elements of Partial Differential Equations

**Reference books:**

**Statistical Physics**

Elements of Probability Theory, Elementary Kinetic Theory, Microcanonical, Canonical & Grand Canonical Ensembles and Their Applications, Quantum Statistics of Ideal Bose Gases, Quantum Statistics of Ideal Fermi Gases

**Reference books:**

**Solid State Physics**


**Reference books:**
- Kittel C., Introduction to Solid State Physics, WSE, 7th ed., 1995

**Optics & Spectroscopy**

Geometrical Optics, Interference, Diffraction, Polarization, Crystal Optics & Lasers, Atomic & Molecular Spectroscopy

**Reference books:**

**Nuclear & Particle Physics**

Nuclear Properties and Nuclear Models, Fission & Fusion, The Quark Model, Elementary Particles, their Classification and Interactions, Particle Accelerators, Conservation Laws of Elementary Particles and Fundamental Interactions

**Reference books:**
- Griffiths, D J, Introduction to Elementary Particles, WIE, 1st ed., 1987

**SYLLABUS FOR SPECIAL TEST IN SANITATION SCIENCE, TECHNOLOGY AND MANAGEMENT**

**Environmental Pollution**

Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution,
Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution.

**Reference books:**

Erach Bharucha, Text book for Environmental Studies, University Grants Commission, New Delhi, India, 2004

### Water and Wastewater Treatment

Water and wastewater characteristics; Basic unit processes and operations for water treatment; Drinking water standards; Distribution of water; Sewage and sewerage treatment; Primary, secondary and tertiary treatment of wastewater, effluent discharge standards; Sludge disposal.

**Reference books:**


### Measurement of Water Quality

Sampling, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Organic Carbon, Turbidity, Color, Taste, and Odor, Alkalinity, Solids, Nitrogen and Phosphorus, Pathogens, Heavy Metals, Other Organic Compounds

**Reference books**


### Sludge Treatment and Disposal

Sources of Sludge, Characteristics of Sludges, Sludge Treatment, Ultimate Disposal

**Reference books:**


### Solid Waste Management

Quantities and Characteristics of Municipal Solid Waste, Collection, Disposal Options

**Reference books:**


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**SYLLABUS FOR SPECIAL TEST IN SOFTWARE SYSTEMS**

### Structured Programming in C

Control Constructs: Conditionals, Loops, and Jumps, Tuples, Unions, and Lists, Functions and Variables, Recursion, Memory Allocation model, Dynamic Memory Allocation – Pointers and Address Arithmetic,
Dynamically Allocated Data and Linked Lists.

**Reference books:**


**Advanced Programming in C**


**Reference books:**


**Object Orientation and Software Engineering**


**Reference books:**


**Database Systems**

Database Modeling & Design – ER modeling, Normalization Techniques, Database Querying – SQL.

**Reference books**


**Core Systems**


**Reference books**
