National Entrance Screening Test 2020

NEST 2020

Information Brochure & Syllabus

Entrance test for admission to

5-year Integrated MSc Program, 2020-25

at

National Institute of Science Education and Research (NISER) Bhubaneswar

and

University of Mumbai - Department of Atomic Energy Centre for Excellence in Basic Sciences (UM-DAE CEBS) Mumbai

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Introduction to NEST 2020

The **National Entrance Screening Test** or NEST is a compulsory online/computer based test for admission to the five year Integrated MSc programme in Biology, Chemistry, Mathematics and Physics, at National Institute of Science Education and Research (NISER), Bhubaneswar and University of Mumbai – Department of Atomic Energy Centre for Excellence in Basic Sciences (UM–DAE CEBS), Mumbai.

Integrated MSc program at NISER, Bhubaneswar & UM-DAE CEBS, Mumbai:

Both NISER and UM-DAE CEBS are autonomous institutions established by Department of Atomic Energy (DAE), Government of India, in 2007. NISER is an off-campus centre of Homi Bhabha National Institute (HBNI) and all academic programmes of NISER are affiliated to HBNI. Although CEBS is a DAE institution, it is physically located in the Kalina campus of University of Mumbai and the degrees to students are awarded by Mumbai University. These institutes were started with the mandate to provide high quality teaching in basic sciences by a faculty of distinguished scientists embedded in a vibrant research environment, and to create a national pool of scientists ready to take up research challenges in the frontiers of basic and applied sciences. The Integrated MSc programme at these institutes follows a semester–based course structure and continuous assessment within a flexible and innovative academic curriculum, exposing the students to research early in the programme. The placements of the graduated students from NISER and CEBS provide testimony of success of this initiative.

NISER and CEBS are residential institutes equipped with state of art teaching and research laboratories, modern computational facilities, computer centres and excellent libraries. All the students (girls and boys) are accommodated in hostels on campus, and are provided with an environment conducive to their success in classroom learning and research.

NISER, Bhubaneswar and UM-DAE CEBS, Mumbai are in compliance with the UGC and Govt. of India guidelines on anti-ragging. Ragging in any form is a punishable offence and hence is totally prohibited on these campuses. Any complaint regarding ragging can be made at the 24x7 toll-free National Anti-Ragging Help Line number 1800-180-5522 and/or at the email-ID : helpline@antiragging.in.

The candidates admitted to the programme are eligible to receive annual scholarship of Rs 60,000 through DISHA program of Department of Atomic Energy, Government of India. In addition, the scholarship recipients receive grant of Rs 20,000 per annum for summer internship. Candidates selected by DST for the INSPIRE-SHE program are endorsed for INSPIRE scholarship by NISER and CEBS. Alumni of the programme are presently pursuing PhD at the reputed universities and institutes in India & abroad.

Besides, top performers at NISER and CEBS, securing overall grades above certain threshold at the end of the programme, are eligible to appear directly for the interview for admission to Bhabha Atomic Research Centre (BARC) training school.

The details of the Integrated MSc programme, list of courses, research activities of the individual schools, institute facilities and faculty profiles at NISER and CEBS may be found on their respective websites (*www.niser.ac.in* and *www.cbs.ac.in*).

Eligibility criteria for admission to the programme:

***Educational qualification*:** Candidates seeking admission to NISER and UM–DAE CEBS for the Integrated MSc programme 2020–25 should be from regular science stream in classes XI and XII. It is mandatory for all aspiring candidates to write the NEST 2020 examination. Candidates must have passed class XII examination or equivalent from any recognised Board in India in the years 2018 or 2019 or be appearing for the same in 2020. Candidates who are appearing for the board examination in 2020 must pass it by the time of admission into the programme. Also, candidates must secure at least 60% marks in aggregate or equivalent grade in class XII examination to be eligible for admission to NISER and CEBS. Candidates satisfying all the above criteria will be considered for admission strictly on the basis of Merit List of NEST 2020. For candidates belonging to scheduled castes (SC), scheduled tribes (ST) and Divyangjan categories, the minimum requirement of marks is relaxed to 55% in aggregate. Where only letter grades are available, a certificate from the concerned Board specifying equivalent percentage of marks is required to be submitted. In absence of such a certificate, the decision of the admissions committee of the concerned institution will be final.

***Age limit*:** General and OBC category candidates born on or after **August 01, 2000** are eligible for admission to the integrated MSc programme of NISER/CEBS. The age limit is relaxed by 5 years for SC / ST / Divyangjan candidates.

Eligibility criteria summary: a candidate becomes eligible for the programme when he/she satisfies following **all four** criteria:

(a) Secures a position in the NEST merit list. Please refer to page 10 of this document for the rules of merit list preparation.

(b) Pass the XII standard board examination or equivalent in the science stream in the years 2018 or 2019 or appeared in 2020 from any recognised Higher Secondary Education Board in India.

(c) Secures at least 60% in aggregate in the XII standard board examination. For SC/ST/Divyangjan candidates the requirement is 55%.

(d) Born on or after August 01, 2000. For SC/ST/Divyangjan students the limit is relaxed by five years.

Note: *necessary certificates supporting eligibility criteria have to be furnished only at the time of admission. Offer of admission is subject to verification of all original certificates at the time of admission/counselling and availability of seats.*

Certificates in support of eligibility criteria need not be produced for appearing in NEST 2020 examination.

Reservation of seats:

For the Integrated MSc programme 2020–25, total number of seats at NISER and CEBS are 200 and 57, respectively. NISER and CEBS follow the Govt. of India rules for reservation of seats. The categories and the extent of reservation are as follows:

Other Backward Classes belonging to the Non–Creamy Layer (OBC–NCL): 27% of seats are reserved for OBC–NCL. The class should have been mentioned in the central list of OBCs (*http://www.ncbc.nic.in/User_Panel/CentralListStateView.aspx*). If offered admission under this category candidate must produce the OBC-NCL Certificate valid on the day of admission.

Candidates belonging to the creamy layer of OBC are **NOT** entitled for reservation. Such candidates are treated as belonging to the General category. The Socially and Educationally Backward Classes (SEBC) as notified by some of the State Governments are as such **NOT** eligible to avail any reservation unless they satisfy the OBC–NCL criteria.

Reservation for Economically Weaker Sections (EWS) of society is allowed in the General-EWS category for admission to CEBS.

Scheduled Caste (SC) / Scheduled Tribe (ST): 15% seats are reserved for SC and 7.5% seats for are reserved for ST categories. The benefit of reservation will be given only to those castes and tribes that are mentioned in the respective lists of corresponding states published by the Government of India: *(http://socialjustice.nic.in/UserView/index?mid=76750 and https://tribal.nic.in/ST/LatestListofScheduledtribes.pdf)*.

The number of seats reserved for SC, ST, OBC (Non–Creamy–Layer) and Divyangjan candidates is according to the Government of India norms. To claim seats under reserved category, relevant documents must be furnished at the time of admission. All category certificates should be written in either English or Hindi. In case certificates are written in any other language, a translated copy must also be provided.

Divyangjan: 5% of seats are reserved in every category, i.e., General, OBC–NCL, SC and ST for persons with disabilities (Divyangjan). Benefit would be given only to those who have at least 40% impairment irrespective of the type of disability i.e., locomotor, visual or dyslexic. Leprosy–cured candidates who are otherwise fit to pursue the course are also included in this sub–category. Candidates are advised to ensure that the certificate is in accordance with the latest guidelines of the Government of India (visit the web site of the Ministry of Social Justice and Empowerment, Department of Disability Affairs for latest information).

The reservation for Divyangjan candidates is horizontal and hence, unfilled seats will be allotted to candidates belonging to the respective categories i.e., unfilled SC (Divyangjan) seats will be allotted to candidates belonging to the SC category and so on.

If selected, the candidates must produce all original certificates at the time of admission failing which the offer of admission will be cancelled.

NEST 2020 Examination:

The NEST 2020 examination will be conducted at multiple centres (major towns or cities) all over India on **June 06, 2020 (Saturday), 9:00 AM – 12:30 PM (first session) and 2:00 PM – 5:30 PM (second session)**. The candidates will be assigned to either of the sessions. Based on the performance in NEST 2020, Merit List of the candidates will be prepared for NISER and CEBS **separately** (see Merit list preparation section on page 10) and posted on NEST 2020 website (*www.nestexam.in*) on **June 16, 2020.**

NEST 2020 examination will be a Computer-Based Test (CBT/online exam)

***Examination centres*:** A proposed list of about 90 centres (cities and towns of India) for the NEST examination is given in the table below. Candidates must choose **5 (five)** centres in order of their preference while filling out the application form. Every effort will be made to allot the centre of first preference. Please note that ultimately, the allotment of an examination centre by the NEST Committee has to be regarded as final and request for change of centre will, in general, not be entertained. The address of the test venue allotted to the applicant, will be mentioned on the NEST admit card. Admit cards will be available for download from online application portal from **April 24, 2020**. Refer to the section '**How to Apply**' below for details on online registration and application process.

Code	Centre Name	Code	Centre Name	Code	Centre Name
1	Guntur [AP]	32	Kollam [KL]	63	Jalandhar [PB]
2	Kurnool [AP]	33	Kottayam [KL]	64	Mohali [PB]
3	Rajahmundry [AP]	34	Kozhikode [KL]	65	Jaipur [RJ]
4	Tirupathi [AP]	35	Malappuram [KL]	66	Jodhpur [RJ]
5	Vijayawada [AP]	36	Palakkad [KL]	67	Udaipur [RJ]
6	Visakhapatnam [AP]	37	Pathanamthitta [KL]	68	Chennai [TN]
7	Vizianagaram [AP]	38	Thiruvananthapuram [KL]	69	Coimbatore [TN]
8	Guwahati [AS]	39	Thrissur [KL]	70	Madurai [TN]
9	Patna [BR]	40	Bhopal [MP]	71	Salem [TN]
10	Chandigarh [CH]	41	Gwalior [MP]	72	Tiruchirappalli [TN]
11	Bhilai Nagar [CG]	42	Indore [MP]	73	Tirunelveli [TN]
12	Raipur [CG]	43	Jabalpur [MP]	74	Hyderabad [TS]
13	New Delhi [DL]	44	Mumbai [MH]	75	Karimnagar [TS]
14	Ahmedabad [GJ]	45	Nagpur [MH]	76	Warangal [TS]
15	Hamirpur [HP]	46	Pune [MH]	77	Agartala [TR]
16	Shimla [HP]	47	Imphal [MN]	78	Allahabad [UP]
17	Jammu [JK]	48	Shillong [ML]	79	Kanpur [UP]
18	Srinagar [JK]	49	Angul [OD]	80	Lucknow [UP]
19	Bokaro Steel City [JH]	50	Balasore [OD]	81	Noida [UP]
20	Dhanbad [JH]	51	Bargarh [OD]	82	Varanasi [UP]
21	Jamshedpur [JH]	52	Baripada [OD]	83	Dehradun [UK]
22	Ranchi [JH]	53	Berhampur-Ganjam [OD]	84	Haldwani [UK]
23	Bengaluru [KA]	54	Bhubaneswar [OD]	85	Roorkee [UK]
24	Hubballi (Hubli) [KA]	55	Cuttack [OD]	86	Asansol [WB]
25	Mangaluru (Mangalore) [KA]	56	Dhenkanal [OD]	87	Burdwan [WB]
26	Mysuru (Mysore) [KA]	57	Jharsuguda [OD]	88	Durgapur [WB]
27	Alappuzha [KL]	58	Khurda [OD]	89	Hooghly [WB]
28	Ernakulam [KL]	59	Rayagada [OD]	90	Kolkata [WB]

29	Idukki [KL]	60	Rourkela [OD]	91	Siliguri [WB]
30	Kannur [KL]	61	Sambalpur [OD]	-	-
31	Kasaragod [KL]	62	Bhatinda [PB]	-	-

Any five cities from the above list, as per applicant's preference, have to be chosen while filling out the application form. Depending on the number of applicants opting for a particular test city/town, NEST 2020 committee reserves the right to cancel or add any of the test cities without prior notice to applicants. Address of the NEST test centre allotted to an applicant will be printed in the admit card. Only this test centre should be treated as final, irrespective of the order of preference of test cities filled in at the time of online application.

***Examination rules*:** Candidates must reach the test venue at least thirty minutes before the examination commences. The examination is of 3 hours and 30 minutes duration. It will start at 9:00 AM for the first session and 2 PM for the second session. Candidates will not be allowed to enter the examination hall after 9:30 AM and 2:30 PM for the respective sessions. The earliest a candidate can leave the examination hall is 11 AM and 4 PM for the respective sessions, unless it becomes necessary to leave earlier on medical grounds. Use of log tables and calculators inside the examination hall is not allowed. Candidates may bring their own pen, pencils. Exchange/sharing of these items with other candidates is strictly prohibited. Candidates MUST bring their Admit Card and their school photo Identity Card or any other photo ID issued by Government agencies to the examination hall. Any candidate found adopting unfair means will be expelled from the examination hall without warning. Mobile phone and other similar electronic gadgets are strictly not allowed inside the examination hall.

NEST 2020 will be conducted in compliance with the guidelines issued by the Government of India regarding scribes for Divyangjan category candidates which can be found at: http://disabilityaffairs.gov.in/upload/uploadfiles/files/Guidelines-29_08_2018%20(1).pdf

Divyangjan category candidates who require the assistance of scribes should bring their scribes complying with the guidelines mentioned above to the examination venue.

***Question type*:** The question paper will consist of 5 (five) sections of objective (MCQ) type questions. Section 1 is the general section and of 30 marks. There will be no negative marking in the general section. Sections 2 through 5 are of 50 marks each and will contain subject specific questions from Biology, Chemistry, Mathematics and Physics. It is in the interest of the candidate to attempt all sections. As the merit list for both the institutes is prepared with best 3 scores of the subject sections (in addition to the general section), and section with the worst score is omitted. Thus attempting all sections will increase their chances of a better total score (**for details of merit list preparation see page 10**). In the subject sections, for certain questions there will be negative marking for incorrect answers. Some questions may have one or more correct answers for which marks can only be earned by marking all correct answers and no wrong answer. For NEST question papers of last few years, refer to the NEST 2020 website (*www.nestexam.in*). Language of the question paper will be English only.

***Answering questions*:** The examination is a Computer Based Test (CBT). The candidate will enter all the requisite details at the given computer terminal. The questions will be displayed on the monitor. The answers to each question are to be provided at the

computer terminal using the given electronic equipment. Details of how to answer at the terminal will be provided before the examination. Applicants are encouraged to practice by using mock test link that will be made available on NEST 2020 web page, two weeks before the exam date. Practice sessions on computer-based test will be available for all applicants on application portal after online registration and complete submission of online application. Application portal will be accessible with correct login credentials only.

***Syllabus*:** The syllabus for NEST 2020 primarily follows the NCERT/CBSE science syllabus of class XI–XII. The detailed syllabus for NEST examination is provided at the end of this document under the heading: 'Syllabus for NEST 2020'. The syllabus can also be downloaded from NEST 2020 website, *www.nestexam.in*. There is, however, no specific syllabus for the general section. This section tests candidate's familiarity with, but not detailed understanding of, major historical milestones in subjects like Astronomy, Biology, Chemistry, Mathematics, Physics, Computer Science and Environmental Science. Questions will be designed to test analytic abilities and comprehension of scientific passages. Some of the questions in this section may require knowledge of class X Mathematics.

Previous NEST question papers are available on NEST website.

How to apply:

To apply for NEST 2020, candidates must fill out the online application form through *www.nestexam.in* on or after **January 7th, 2020**. Candidates are strongly advised to read through the detailed online application procedure available on the website (click on 'How to Apply online'). Online application process closes on **April 3rd, 2020**. **Application can be submitted only through NEST 2020 website**. There is no other mode of application submission.

Login credentials for logging into application submission and fee payment portals will be provided upon online registration.

***Application Fee*:** The application fee for the male candidates of General and OBC categories is ₹1,200/–. The application fee for candidates in the SC/ST/Divyangjan categories and for all female candidates is ₹600/–. Payments can be made using credit card/debit card/net–banking through online payment gateway. Please use Mastercard/Visa/RuPay cards only

Candidates need not send any document to NEST office in the entire application process.

Please refer to the instruction sheet (the 'How to Apply Online' tab on www.nestexam.in) for details regarding application process.

***Admit card*:** The admit card for NEST 2020 will be available for downloading from **April 24, 2020**. Admit cards will **NOT** be dispatched to any applicant. Applicants must download their admit cards from NEST website (after login). The download link will be available only till the day of the examination.

Address for correspondence:

Any NEST 2020 related queries be addressed to:

by postal mail:

Chief Coordinator, NEST 2020
NALANDA Building, UM-DAE CEBS
Opp: Nano Science Building
University of Mumbai, Vidyanagari
Mumbai 400098

by e-mail to: nest2020@cbs.ac.in (for a quicker response e-mail is recommended)

The official website of NEST 2020 is: ***www.nestexam.in***

Important Dates:

- Start of Online application for NEST 2020: **January 07, 2020**
- Closing of Online application: **April 03, 2020**
- Download of Admit Card begins: **April 24, 2020**
- NEST 2020 examination: **June 06, 2020** *(Hours of examination: 9:00 AM – 12:30 PM & 2:00 PM – 5:30 PM)*
- Announcement of results on NEST website: **June 16, 2020**

Important things to remember:

- ✓ Candidates must reach the examination venue at least half an hour (30 minutes) before the start of the examination.
- ✓ Candidates will NOT be allowed to enter the examination hall any later than half an hour (30 minutes) after the start of the examination, i.e. 9:30 AM in first session & 2:30 PM in second session.
- ✓ Candidates will be allowed to leave the examination hall no sooner than two hours after the start of the examination, i.e. 11.00 AM for first session & 4.00 PM for second session (except when required by medical emergencies).
- ✓ Candidates **MUST** bring their Admit Card and a valid photo Identity Card to the examination hall.
- ✓ Use of log tables and calculators in the examination hall is not allowed. Candidates must bring their own blue/black pen.
- ✓ ANY kind of electronic gadgets, including mobile phones, digital/smart watches, storage devices etc., are not allowed inside examination hall.

Important things to remember for online application

- Correct e-mail address should be provided. NEST office communicates with candidates through this e-mail id only.
- The phone number that is provided during application should be accessible by the candidate. NEST office uses this phone number to reach a candidate whenever necessary.
- Properly scanned and cropped passport size photograph should be uploaded. The photo and signature file must be not more than 800 KB and must be in .JPG or .JPEG format only.
- Properly scanned and cropped signature should be uploaded.
- *Applications incomplete in any respect will not be accepted.*
- *Any dispute arising out of or related to the NEST 2020 examination shall be subject to Mumbai jurisdiction.*

Proposed student intake at NISER and CEBS for session 2020-2025:

Number of seats available at NISER and CEBS for admission in the year 2020 would be as follows

Category	NISER	CEBS
General	101	23
General – EWS	0	06
OBC - NCL	54	15
SC	30	09
ST	15	04
Divyangjan	5% seats in each category	5% seats in each category
Total	200	57
Total proposed intake	**200**	**57**

A student with certain category rank will take a general seat if he/she secures a suitable general ranking.

For example, if the topper of the exam (General rank 1) happens to be an OBC candidate, he/she would get OBC rank 1, as well. In such case, he/she would be admitted against the General rank so that all OBC seats remain available even after his/her admission.

NEST 2020 Merit List preparation

This section lists rules employed for the preparation of merit list in National Entrance Screening Test (NEST) 2020.

I. Scoring system

1. In NEST 2020 examination, there would be a general section of 30 marks and four subject sections of 50 marks each.

2. NEST 2020 entrance exam will be conducted in two sessions and different sets of question papers will be used for each session. The percentile score will be calculated on the basis of the relative performance of all the qualified candidates in the respective session. The highest score in each session will be 100th percentile.
3. **Merit lists for NISER and CEBS will be prepared separately**.
4. During preparation of merit list, score for the general section would be considered along with three best scores from the remaining subject sections. In other words, the worst score among sections 2 through 5 would be discarded for the merit list calculation.
5. As merit list calculation will be performed on marks obtained in the general section and in (best) three subject sections, the 'total' marks for NEST 2020 becomes 180 (30 + 50 x 3 = 180).

II. 'Section–wise' Minimum Admissible Score (SMAS) or section-wise cut–off marks

1. Total score of each candidate will be the direct sum of his/her score in the general section and his/her best three scores in the subject sections.
2. For each section, "20% of the average of the best 100 scores in that section" will be considered as Section–wise Minimum Admissible Score (SMAS).

   *For example, if the average of the best 100 scores in Chemistry section is 40 out of 50, then SMAS for chemistry section would be 40*0.20 = 8 marks. Similarly, for other sections.*
3. SMAS for different sections can obviously be of different numerical value.
4. SMAS for the two sessions, for any particular section, can obviously be of different numerical value.
   (a) SMAS in general section is mandatory for entering merit list of NISER and CEBS.
   (b) For NISER: SMAS in all four subject sections is mandatory, in addition to the general section.
   (c) For CEBS: SMAS in any 3 subject sections is mandatory, in addition to the general section.
5. SMAS for OBC students would be 90% of respective SMAS for general category students.
   For example, if in the chemistry section the SMAS is 8 for general category students, then SMAS for OBC students would be 7 (90% of 8, rounded off).
6. SMAS for SC/ST/Divyangjan students would be 50% of respective SMAS for general category students.
   For example, if in the chemistry section the SMAS is 8 for general category students, then SMAS for SC/ST/Divyangjan students would be 4 (50% of 8).

   Example: Suppose the SMAS for the general section is 4 and for all subject section is 8 for a general category candidate. If a certain general category candidate scores 20 out of 30 in general section, 40/50 in Physics, 35/50 in Chemistry, 2/50 in Math and 5/50 in Biology, then his/her total score is 20+40+35+5=100. But as he/she has not scored at least 8 (SMAS) in three subject sections, he/she will not get any merit rank. Note that the marks '2' was not considered as it is the lowest subject score.

III. Overall cut-off or Minimum Admissible Percentile (MAP)

1. In addition to SMAS, a candidate is required to score equal to or above a total Minimum Admissible Percentile (MAP), to get a merit rank.

   i. MAP for NEST 2020 is 95 percentile for general category candidates.

   ii. MAP for NEST 2020 is 90 percentile for OBC candidates.

   iii. MAP for NEST 2020 is 75 percentile for SC/ST/Divyangjan candidates.

2. A candidate scoring less than the above MAP in total (general section + three best scored subjects) would not be allotted any merit rank and would not be deemed eligible for admission, even if he/she secures SMAS in all sections.

IV. Merit list rank preparation

The final ranking of the candidates will be based on percentile scores calculated from best three subject scores and the score in general section. NISER and CEBS will publish **separate merit lists** based on the following criteria defined by NISER and CEBS separately.

A. <u>For NISER Merit List:</u>

1. A candidate is required to score equal to or above a total Minimum Admissible Percentile (MAP), to get a merit rank.
2. A candidate must score equal to or more than the respective SMAS in the general section as well as in **all four subject** sections.
3. Score for the general section along with three best scores from the remaining subject sections will be considered for the merit rank.
4. If percentiles of two or more candidates become equal (i.e. in the case of tie), candidates with higher score in the general section will get a better rank.
5. If the tie persists, then the best scores in the subject section of the two students would be compared. The student with the better score in any of the subject section would get a better rank.
6. If the tie still persists, the students would be given same provisional rank at the time of declaration of the result and the tie would be broken by comparing class 12th marks during admission/counselling. If the tie still persists then the younger student will get a higher rank.

For example, consider the marks of following six students in general category for session-1 and MAP is 95 percentile. Assume SMAS is 8 for all subjects.

Rank	Student	Gen	Bio	Chem	Maths	Phy	Total	Percentile
1	A	27	32	48	37	20	144	100
NA	B	29	0	26	30	23	108	NA
2	C	27	24	34	15	23	108	99.6972
3	D	27	9	28	30	23	108	99.6972
3	E	27	30	24	10	27	108	99.6972
NA	F	27	25	26	2	30	108	NA

NISER Rank: In this example, student A gets rank 1 as his total percentile is more than other students. Please note that A has scored more than SMAS in all subjects and hence best three subject scores are considered. Other five students have equal totals. Amongst them, students B and F will not qualify for getting admitted to NISER as they have scored less than SMAS in Biology and Mathematics, respectively. Student C has scored 34 in Chemistry, whereas D and E have their highest subject section score as 30 (D for Math, and E for Bio). Thus C gets 2nd rank. Tie for D and E is not broken and both students get the same provisional rank.

B. <u>For CEBS Merit List:</u>

All the clauses mentioned above will be applicable for CEBS merit list preparation except IV.A.2. The IV.A.2 clause for CEBS is:

A candidate must score equal to or more than respective SMAS in the general section as well as in **any of the three subject** sections.

For example, in case of CEBS, both students B and F will be allotted merit rank. On the other hand, student G having his/her score is equal to or more than respective SMAS in only two subjects will not be allotted CEBS merit rank as shown in the table below. Assume SMAS is 8 in all sections.

Rank	Student	Gen	Bio	Chem	Maths	Phy	Total	Percentile
1	A	27	32	48	37	20	144	100
2	B	29	0	26	30	23	108	99.6972
3	C	27	24	34	15	23	108	99.6972
4	D	27	9	28	30	23	108	99.6972
4	E	27	30	24	10	27	108	99.6972
4	F	27	25	26	2	30	108	99.6972
NA	G	30	0	38	2	38	108	NA

V. Admission:

Getting a merit rank by satisfying SMAS and MAP criteria does not automatically entitle a candidate to a seat or to be called for admission/counselling. The details of admission/counselling process will be uploaded on the website of the respective institutions sufficiently in advance.

Note: *NEST committee reserves the right to relax any of the defined cut–offs in extenuating circumstances.*

SYLLABUS FOR NEST 2020

General Section:

There is no specific syllabus for the General section. The aim is to test candidate's aptitude for a career in science. Questions are designed to test the candidate's familiarity with (but not a detailed understanding of) major historical milestones in Mathematics, Physics, Chemistry, Biology, Astronomy, Computer science and Environmental studies. There will be some questions designed to test the grasp of Mathematics up to 10th standard and application of the same to simple problems. Some questions in this section aim to test the candidate's general ability to comprehend qualitative and quantitative aspects of a given scientific passage. This is done by giving a passage on some scientific topic and questions based on the concepts elaborated in the passage will be asked. Some questions may aim to find whether the candidates can interpret graphical and/or tabular representation of information.

Biology:

Cell Biology: Cell theory and cells as unit of life. Basic concepts of biomolecules – Proteins, Carbohydrates, Lipids, Nucleic acids. Tools and techniques of cell studies – use of microscope and calibration (microscopy), elements of microscope. Biomembranes – transport mechanism, cellular respiration. Cell organelles – structure and functions. Discovery and structure of DNA, processes of replication, transcription, genetic code and translation. Principles of the basic techniques in molecular biology. Enzymes– catalysis, kinetics, activation energy, competitive and non– competitive inhibition.

Genetics and Evolution: Fundamentals of genetics and evolution. Evidences and theories of organic evolution. Organization of the heredity material in chromosomes. Equational division. Reduction division. Mitosis and meiosis compared and contrasted. Significance of meiosis. Mendel's laws of inheritance. Discovery of linkage, sex–linked inheritance. Crossing– over, stage at which crossing– over occurs. Neurospora genetics. Mutation – discovery, types of Mutation and Mutations in diploids. Role of mutations in evolution. Elaboration of Mendel's laws of inheritance. Monohybrid or Dihybrid crosses. Human genetics – human chromosomes, sex–determination, sex–linked inheritance.

Ecology: Physical and biological factors in influencing organisms. Food chains, pyramids of numbers and biomass. Biological equilibrium. Interspecific associations. Bio–diversity. Flora and fauna. Basics of microbial systems, Ecosystems.

Humans and Environment: Soil, rainfall and temperature with reference to natural resources. Our natural resources – their uses and abuses. Environmental pollution and preventive measures. Biodiversity and conservation.

Biotechnology: Principles of recombinant DNA technology. Applications of biotechnology.

Biology of Animal systems:

Digestive System – Modes of nutrition. Different vitamin compounds and their deficiencies. Structure of alimentary canal and associated glands, digestive enzymes and gastrointestinal hormones. Absorption of products of digestion, peristalsis, balanced diet. Respiratory System – Gaseous exchange in animals. Structure of respiratory organs, mechanism of breathing, gaseous transport, tissue respiration.

Circulatory System – Open and closed systems. Functions of blood and 1ymph. Microscopic structure of blood and blood vessels. Structures and working of heart. Distribution of arteries and veins. Circulation of blood coagulation. Blood groups.

Excretory System – Elimination of nitrogenous waste. Osmoconformers and osmoregulators. Structure and function of kidney tubules. Arrangement of excretory organs.

Nervous System – General account of brain, spinal cord and nerves. Re ex actions (simple and conditioned). Sense organs (eye and ear).

Reproductive System – Sexual and asexual reproduction. General arrangement and functions of reproductive organs.

Developmental Biology: Basic features of development in animals. Types of eggs, fertilization, cleavage, blastula. Stem cells– definition, types, uses, advantages and disadvantages, induced pluripotent stem cells. Different hormones and their roles. Diversity of Animal Life — Principles of classification, binomial nomenclature. General classification of animal phyla up to classes (invertebrates) and up to sub–classes / order (vertebrates), General characters of fishes, amphibians, reptiles, birds and mammals.

Immunology: Basics of immune mechanisms and diseases– active and passive immunity, T- and B-cell responses, antigen presentation, principles of vaccination, monoclonal antibodies and their uses, immunology of AIDS.

Biology of Plant systems: Anatomy and Physiology of Plants – Meristems. Plant growth and development. Internal and external regulators of growth and development in plant. Plant reproduction. Internal structure of root, stem, secondary growth and leaves. Xylem and Phloem – their cell elements and functions. Internal structure of dicot and monocot leaves. Photosynthesis – history, importance, factors and mechanism, stomatal mechanism, transpiration and respiration. Comparative study of dicot and monocot anatomy. Absorption and cell–water relations, transport of water and minerals, tropic and turgor movements. Significance of life–cycles with special reference to alternation of generations as exemplified in Funaria, Selaginella and Pinus (no structural details). Plant hormones.

Systematics: Principles of classical and new systematics. Binomial nomenclature. Familiarity with taxa. Plant breeding and tissue culture.

Chemistry:

Physical Chemistry:

Measurements in chemistry - SI units for fundamental quantities, significant figures in calculations.

Mole concept - Avogadro number and mole concept, molar masses, mole fraction, molarity, molality, percent composition, stoichiometry. Equivalent weight and normality. Calculations based on mole concept and stoichiometry of different reactions. Oxidation–reduction reactions.

Gaseous and liquid states - Absolute scale of temperature. Gas laws, ideal gas equation, real gases and deviation from ideality, liquefaction of gases, van der Waals equation.

Kinetic theory of gases; average, root mean square and most probable velocities and their relation with temperature. Law of partial pressures. Vapour pressure. Diffusion of gases.

Atomic structure and chemical bonding - Bohr model, spectrum of hydrogen atom, quantum numbers. Wave particle duality, de Broglie hypothesis. Uncertainty principle. Orbitals and quantum numbers; shapes and energy of *s*, *p* and *d* orbitals. Electronic configurations of elements (up to atomic number 36), filling of orbitals – Aufbau principle. Pauli's exclusion principle and Hund's rule. Hybridization involving *s*, *p* and *d* orbitals. Atomic orbital overlap and chemical bonds; ionic, covalent and coordinate bonds; bond parameters. Orbital energy diagrams for homo–nuclear diatomic species. Lewis structures. Hydrogen bond. Polarity in molecules, dipole moment (qualitative aspects). VSEPR theory and shapes of molecules. Valence Bond Theory. Molecular orbital theory of homo–nuclear diatomic molecules (qualitative idea).

Thermodynamics - Thermodynamic states. First law of thermodynamics. Internal energy, work and heat, pressure–volume work. Enthalpy and enthalpy change, Hess's law, heat of – reaction, fusion and vaporisation. Second law of thermodynamics, entropy, free energy, criterion of spontaneity.

Chemical equilibrium - Laws of chemical Equilibrium, law of mass action. Equilibrium constant – factors affecting equilibrium constant and its applications. Le Chatelier's

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principle - effect of concentration, temperature and pressure. Significance of ΔG and ΔG in chemical equilibrium. Relationship of K and ΔG. **Ionic equilibrium.** Acids and bases (Bronsted and Lewis concepts), salts. Ka, Kb, Kw, degree of dissociation, pH and their relationships. Solubility product, common ion effect. Hydrolysis of salts. Buffer solutions. **Electrochemistry -** Redox reactions and electrode potential, Electrochemical cells,
Galvanic cells and cell reactions. Standard electrode potential. Nernst equation and its relation to ΔG and K. Electrochemical series, emf of galvanic cells. Electrolysis and Faraday's laws of electrolysis. Electrolytic conductance, specific, equivalent and molar conductivity, Kohlrausch's law. Concentration cells. Batteries (primary and secondary), fuel cells, corrosion. **Chemical kinetics -** Rates of chemical reactions. Order of reaction, rate constant. First order and pseudo first order reactions. Factors affecting rate of reaction – concentration, temperature (Arrhenius equation), catalyst.

Solid state - Classification of solids, amorphous and crystalline solids, crystalline state, crystal lattice and unit cells; seven crystal systems (cell parameters a, b, c, a, β,), close packed structure of solids (cubic), packing in fcc, bcc and hcp lattices. Packing efficiency, nearest neighbours, ionic radii. Simple ionic compounds, Imperfection in solids, point defects. Electrical and magnetic properties, band theory of metals.

Solutions - Solution of solid and gas in liquid. Concentration of solution. Ideal and non-ideal solutions. Colligative properties. Vapour pressure of solution, Raoult's law. Molecular weight determination from lowering of vapour pressure, elevation of boiling point and depression of freezing point. Abnormal molecular mass, van't Hoff factor. Osmosis – Osmotic pressure, reverse osmosis.

Surface chemistry:

(a) Adsorption – Physisorption and chemisorptions. Factors affecting adsorption of gases on solids. Adsorption isotherm. Catalysis – homogeneous and heterogeneous, Activity and selectivity. Enzyme catalysis.

(b) Colloidal state – Types, preparation and properties of colloids. Tyndall effect, Brownian movement, electrophoresis, coagulation. Application of colloids. Micelles.

Inorganic Chemistry:

Classification of elements and periodicity in properties - Modern periodic table, classification of elements, periodic trends in properties of elements – valence, oxidation state, atomic/ionic radius, ionization energy, electron gain energy, electronegativity, valency, chemical reactivity. Diagonal relationship. Anomalous behaviours of Li, Be, B, C. **Hydrogen -** Isotopes, preparation, isolation, properties and uses. Hydrides – ionic, covalent and interstitial. Properties of water and heavy water. Hydrogen peroxide – Preparation, structure, reactions, uses. Hydrogen as fuel cell.

s– Block elements (Alkali and alkaline earth elements) – General characteristics and trends in properties.

(a) **Group 1:** Preparation, properties and reactions of alkali metals with emphasis on chemistry of Na and K and their compounds – oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates. Uses.

(b) **Group 2:** Preparation, properties and reactions alkaline earth metals with emphasis on the chemistry of Mg and Ca and their compounds – oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates. Uses.

p– Block elements - General characteristics and trends in properties.

(a) Group 13: Chemistry of Boron and its compounds – borax, boric acid and diborane.

(b) Group 14, 15 and 16: Chemistry of carbon, sulphur, nitrogen and phosphorus. Allotropy. Chemistry of oxides and oxyacids of these elements. Phosphines, phosphorus chlorides, ammonia, peroxide and ozone; silicones, silicon tetrachloride and silicates.

(c) Group 17: Chemistry of halogens, chemistry of chlorine in detail. Interhalogen compounds. HX and oxyacids of halogens.

(d) Group 18: Isolation, properties and reactions of inert gases with emphasis on chemistry of Xenon. **d–Block elements -** (Mainly 3d elements) General characteristics and trends in properties.

Variable oxidation states and their stabilities, colour (excluding the details of electronic transitions) and calculation of spin–only magnetic moment. Catalytic properties. Interstitial compounds, alloy formation. Preparation and properties of potassium dichromate and permanganate. **f–Block elements-** (mainly lanthanides) General characteristics and trends in properties.

Variable oxidation states. Lanthanide contraction and its consequences.

Coordination compounds -Nomenclature of mononuclear coordination compounds. Isomerism. Hybridization and geometries of mononuclear coordination compounds. Magnetic properties. Werner's theory, VBT, CFT.

Metals and metallurgy - Occurrence of metals. General methods of extraction involving chemical principles – thermodynamic, electrochemical and redox principles. General operation stages involved in metallurgical operation. Metallurgy of *p*–block element (emphasis on Al). Metallurgy of Fe–triad (more emphasis on Fe metallurgy). Metallurgy of coinage metals (Cu, Ag with more emphasis on Cu). Refining.

Organic Chemistry:

Basic concepts - Representation of organic compounds. Hybridisations of carbon. Sigma and pi– bonds. Shapes of simple organic molecules. Inductive effect, electromeric effect, resonance effect, hyperconjugation. Keto–enol tautomerism. Determination of empirical and molecular formulae (only combustion method). Hydrogen bond – definition and effect on physical properties of alcohols and carboxylic acids. Acidity and basicity of organic acids and bases. Methods of purification of compounds.

Reactive intermediates - Homolytic and heterolytic bond cleavages. Formation, structure and stability of – carbocation, carbanion and free radical. **Isomerism -** Structural and stereoisomerism. Geometrical isomerism. Chirality. Enantiomers. Optical isomerism of compounds containing up to two asymmetric centres, (*R*, *S* and *E*, *Z* nomenclature excluded). Racemic mixture. Conformations of ethane and butane (Newman projections).

Nomenclature - IUPAC nomenclature of simple organic compounds (only hydrocarbons, mono– functional and bi–functional compounds), including benzene derivatives. **Alkanes -** Preparation, properties and reactions. Idea of homologous series Combustion and halogenation of alkanes. Mechanism of photohalogenation, Wurtz reaction.

Alkenes and Alkynes - Preparation, properties and reactions of alkenes and alkynes. Isomerization. Acidity of alkynes. Acid catalysed hydration of alkenes and alkynes (excluding the stereochemistry), Reactions of alkenes with KMnO4, sulphuric acid,

Reduction of alkenes and alkynes, Preparation of alkenes and alkynes by elimination reactions (excluding stereochemistry), Electrophilic addition reactions of alkenes with X2, HX, HOX and H2O (X=halogen). Makowniko rule. Peroxide effect. Polymerization of alkenes, Addition reactions of alkynes, Metal acetylides, Ozonolysis

Aromatic compounds - Aromaticity. Huckel theory of aromaticity. Structure of benzene. Isomerism in substituted benzenes. Electrophilic substitution reaction on benzene– General mechanism. Orientating influence of substituents in electrophilic substitution reaction of monosubstituted benzenes. Electrophilic substitution reactions of benzene and substituted benzenes – halogenation, nitration, sulphonation, Friedel–Crafts alkylation and acylation (No mechanism).

Haloalkanes (Alkyl halides) - Preparation from alkanes, alcohols, ole ns. Grignard reagents and their reaction with aldehydes/ketones/esters/nitriles. Nucleophilic substitution reactions of alkyl halides with different nucleophilic species. SN1 and SN2 reactions with mechanism.

Halogen exchange reaction. Polyhalogen compounds. **Haloarenes -** Nucleophilic aromatic substitution in haloarenes and substituted haloarenes (excluding Benzyne

mechanism and Cine substitution). **Alcohols -** Preparation from – ole ns, alkyl halides, carboxylic acids, aldehydes/ketones. Hydroboration reaction. Dehydration, oxidation to aldehydes and ketones. Reaction with sodium, phosphorus halides, $ZnCl_2$/ HX, H_2SO_4. Identification of p–, sec– and tert– alcohols.

Uses of methanol and ethanol.

Phenols - Preparation of phenol from halobenzene, cumene and benzene sulphonic acid. Acidity. Reactions of phenols – halogenation, nitration, sulphonation, with Zn. Reimer–Tieman reaction, Kolbe reaction.

Ethers - Preparation by Williamson's Synthesis, dehydration of alcohols. Reaction with H2O, HX.

Aldehydes and Ketones – Preparation of aldehydes and ketones from – Alcohols, olefins, acid chlorides, arylalkanes, nitriles, esters, Friedel–Crafts reaction. Reactions with – Alcohols, HCN, NaHSO3. Reactions– oxidation, reduction, oxime and hydrazone formation. Aldol condensation, Perkin reaction. Cannizzaro reaction. Haloform reaction. Tests to distinguish aldehydes and ketones. **Carboxylic acids** – Acidity and structure–acidity relationship. Preparation of acids.

Preparation of amides, acid chlorides, esters and anhydrides. ester hydrolysis. Reactions of acids with – thionyl chloride, P–halides, ammonia, alkalis, metals, halogens, reducing agents. Decarboxylation. Halogenation.

Amines – Basicity and structure–basicity relationship. Identification of p–, sec– and tert– amines. Preparation of amines from – nitro compounds, nitriles, amides, haloalkanes/aromatic compounds. Reaction with – Acids, alkylating agents, acylating agents, nitrous acid. Diazotization of aromatic primary amines – Reactions of aromatic diazonium salts – azo coupling reaction, Sandmeyer and related reactions. Carbylamine reaction of p–amines.

Carbohydrate - Classification of carbohydrates. mono– and di– saccharides (glucose and sucrose). Characteristic tests. Structure of glucose. Reactions of glucose– Oxidation, reduction, hydroxylamine, HI, acetic anhydride. Cyclic structure of glucose. Structures of – Sucrose, maltose, starch and cellulose. Glycoside formation and hydrolysis of sucrose.

Amino acids and proteins - a–amino acids. General structure of peptides and proteins. Peptide bond. Characteristic tests. Separation of amino acids using physical properties. Denaturation of proteins. Enzymes.

Polymers: Classification. Homo and co–polymers, Addition and condensation polymerizations. Polythene, nylons, polyesters, Bakelite, melamine–formaldehyde, rubber – natural and synthetic.

Mathematics:

Algebra:

Algebra of complex numbers, addition, multiplication, conjugation, polar representation, properties of modulus and principal argument, triangle inequality, cube roots of unity, geometric interpretations.

Quadratic equations with real coefficients, relations between roots and coefficients, formation of quadratic equations with given roots, symmetric functions of roots.

Arithmetic, geometric and harmonic progressions, arithmetic, geometric and harmonic means, sums of finite arithmetic and geometric progressions, infinite geometric series, sums of squares and cubes of the first n natural numbers.

Logarithms and their properties.

Permutations and combinations, Binomial theorem for positive integral index, properties of binomial coefficients. Matrices as a rectangular array of real numbers, equality of matrices, addition, multiplication by a scalar and product of matrices, transpose of a matrix, determinant of a square matrix of order up to three, inverse of a square matrix of order up to three, properties of these matrix operations, diagonal, symmetric and skew–symmetric matrices and their properties, solutions of simultaneous linear equations in two or three variables.

Addition and multiplication rules of probability, conditional probability, Bayes Theorem, independence of events, computation of probability of events using permutations and combinations.

Trigonometry:

Trigonometric functions, their periodicity and graphs, addition and subtraction formulae, formulae involving multiple and sub–multiple angles, general solution of trigonometric equations.

Relations between sides and angles of a triangle, sine rule, cosine rule, half–angle formula and the area of a triangle, inverse trigonometric functions (principal value only).

Analytical geometry:

Two dimensions – Cartesian coordinates, distance between two points, section formulae, shift of origin. Equation of a straight line in various forms, angle between two lines, distance of a point from a line. Lines through the point of intersection of two given lines, equation of the bisector of the angle between two lines, concurrency of lines. Centroid, orthocentre, incentre and circumcentre of a triangle.

Equation of a circle in various forms, equations of tangent, normal and chord. Parametric equations of a circle, intersection of a circle with a straight line or a circle, equation of a circle through the points of intersection of two circles and those of a circle and a straight line.

Equations of a parabola, ellipse and hyperbola in standard form, their foci, directrices and eccentricity, parametric equations, equations of tangent and normal. Locus Problems.

Three dimensions – Direction cosines and direction ratios, equation of a straight line in space, equation of a plane, distance of a point from a plane.

Differential calculus:

Real valued functions of a real variable, into, onto and one–to–one functions, sum, difference, product and quotient of two functions, composite functions, absolute value, polynomial, rational, trigonometric, exponential and logarithmic functions.

Limit and continuity of a function, limit and continuity of the sum, difference, product and quotient of two functions, L'Hospital rule for evaluation of limits of functions.

Even and odd functions, inverse of a function, continuity of composite functions, intermediate value property of continuous functions. Derivative of a function, derivative of the sum, difference, product and quotient of two functions, chain rule, derivatives of polynomial, rational, trigonometric, inverse trigonometric, exponential and logarithmic functions.

Derivatives of implicit functions, derivatives up to order two, geometrical interpretation of the derivative, tangents and normals, increasing and decreasing functions, maximum and minimum values of a function, Rolle's Theorem and Lagrange's Mean Value Theorem.

Integral calculus:

Integration as the inverse process of differentiation, indefinite integrals of standard functions, definite integrals and their properties, Fundamental Theorem of Integral Calculus.

Integration by parts, integration by the methods of substitution and partial fractions, application of definite integrals to the determination of areas involving simple curves.

Formation of ordinary differential equations, solution of homogeneous differential equations, separation of variables method, linear first order differential equations.

Vectors:

Addition of vectors, scalar multiplication, dot and cross products, scalar triple products and their geometrical interpretations.

Physics:

*General***:** Units and dimensions, dimensional analysis, least count, significant figures. Methods of measurement (Direct, Indirect, Null) and measurement of length, time, mass, temperature, potential difference, current and resistance.

Design of some simple experiments, such as: i) Searle's method to determine Young's modulus, ii) determination of 'g' by simple pendulum, iii) speed of sound using resonance tube, iv) coefficient of friction using angle of repose, v) determination of focal length of a convex lens by plotting a graph between 'u' and 'v', vi) refractive index of material of prism using the method of minimum deviation, vii) verification of Ohm's law, viii) resistance of galvanometer using half deflection method, ix) specific heat of a liquid using calorimeter, x) I–V characteristic curve for p–n junction in forward and reverse bias.

Graphical representation and interpretation of data. Errors in the measurements and error analysis. *Mechanics***:** Kinematics in one and two dimensions (Cartesian coordinates only), projectiles. Uniform circular motion. Relative velocity. Newton's laws of motion. Inertial and uniformly accelerated (linear only) frames of reference. Static and dynamic friction. Kinetic and potential energy. Linear and circular simple harmonic motion. Work and power. Conservation of linear momentum and mechanical energy.

Systems of particles. Centre of mass and its motion. Centre of gravity. Impulse. Elastic and inelastic collisions.

Law of gravitation. Centripetal acceleration and centrifugal force. Gravitational potential and field. Acceleration due to gravity. Motion of planets and satellites in circular orbits. Escape velocity.

Rigid body, moment of inertia, parallel and perpendicular axes theorems, moment of inertia of uniform bodies with simple geometrical shapes. Angular momentum, Torque.

Conservation of angular momentum. Dynamics of rigid bodies with fixed axis of rotation. Rolling without slipping of rings, cylinders and spheres. Equilibrium of rigid bodies. Collision of point masses with rigid bodies.

Hooke's law and stress – strain relations. Elastic limit, plastic deformation. Young's modulus, bulk and shear moduli.

Pressure in a fluid. Pascal's law. Buoyancy. Surface energy and surface tension, capillary rise. Viscosity – Stoke's and Poiseuille's law, Terminal velocity. Qualitative understanding of turbulence. Reynolds number. Streamline flow, equation of continuity. Bernoulli's theorem.

Sound and mechanical waves: Plane wave motion, longitudinal and transverse waves, superposition of waves. Progressive and stationary waves. Vibration of strings and air columns. Resonance (qualitative understanding). Beats. Speed of sound in gases. Doppler effect.

Thermal physics: Thermal expansion of solids, liquids and gases. Calorimetry, latent heat. Heat conduction in one dimension. Elementary concepts of convection and radiation. Newton's law of cooling. Ideal gas laws. Specific heats (C_V and C_P for monatomic and diatomic gases). Isothermal and adiabatic processes, bulk modulus of gases. Equivalence of heat and work. First and second law of thermodynamics and its applications (only for ideal gases). Entropy. Blackbody radiation – absorptive and emissive powers. Kirchhoff's law. Wien's displacement law, Stefan's law.

Electricity and magnetism: Coulomb's law. Electric field and potential. Electrical potential energy of a system of point charges and of electrical dipoles in a uniform electrostatic field; Electric field lines. Flux of electric field. Gauss's law and its application in simple cases, such as to find field due to infinitely long straight wire. uniformly charged infinite plane sheet and uniformly charged thin spherical shell.

Capacitance – Calculation of capacitance with and without dielectrics. Capacitors in series and parallel. Energy stored in a capacitor.

Electric current. Ohm's law. Series and parallel arrangements of resistances and cells. Kirchhoff's laws and simple applications; Heating effect of current.

Biot–Savart's law and Ampere's law. Magnetic field near a current carrying straight wire, along the axis of a circular coil and inside a long straight solenoid. Force on a moving charge and on a current carrying wire in a uniform magnetic field.

Magnetic moment of a current loop. Effect of a uniform magnetic field on a current loop. Moving coil galvanometer, voltmeter, ammeter and their conversions.

Electromagnetic induction – Faraday's law, Lenz's law. Self and mutual inductance. RC, LR and LC circuits with AC sources.

Optics: Rectilinear propagation of light. Reflection and refraction at plane and spherical surfaces, Deviation and dispersion of light by a prism. Thin lenses. Combination of mirrors and thin lenses. Magnification. Wave nature of light – Huygen's principle, interference limited to Young's double slit experiment. Elementary idea of diffraction – Rayleigh criterion. Elementary idea of polarization – Brewster's law and the law of Malus.

Modern physics: Atomic nucleus. Alpha, beta and gamma radiations. Law of radioactive decay. Decay constant. Half–life and mean life. Binding energy and its calculation. Fission and fusion processes. Energy calculation in these processes.

Photoelectric effect. Bohr's theory of hydrogen like atoms. Characteristic and continuous X–rays, Moseley's law. de Broglie wavelength of matter waves. Heisenberg's uncertainty principle.