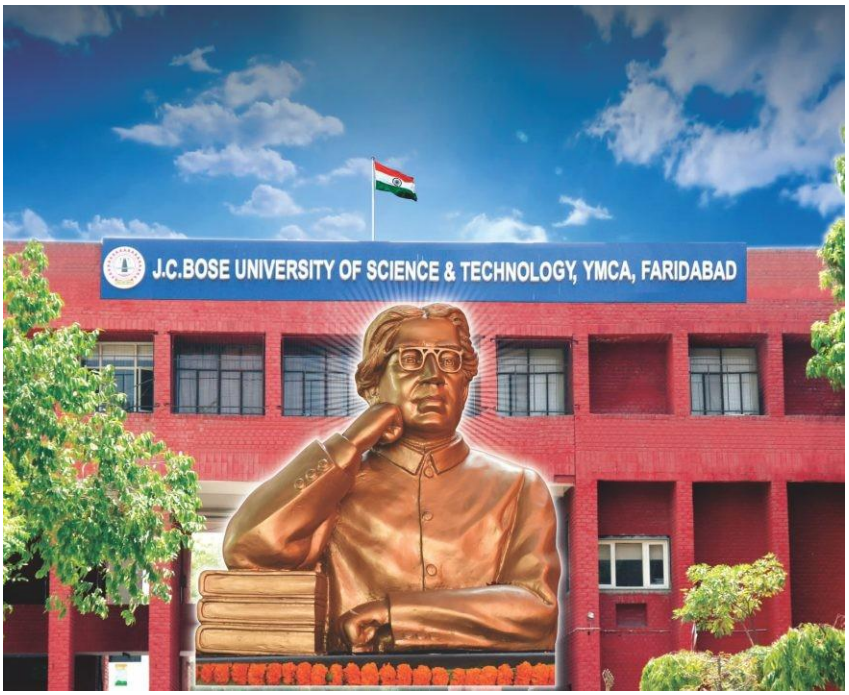
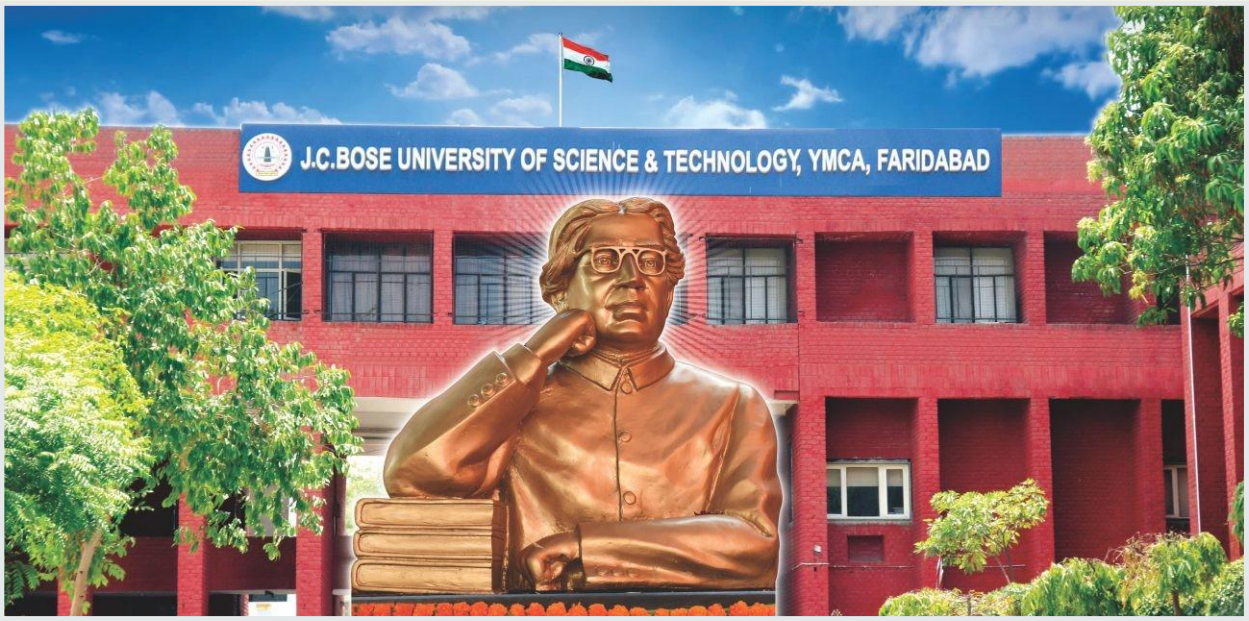
J.C. BOSE UNIVERSITY
OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD (HARYANA)

Ph.D.
Information Brochure



2025-26

jcboseust.ac.in | /JCBoseUST



J.C. Bose University of Science and Technology, YMCA, Faridabad formerly known as YMCA University of Science and Technology, Faridabad was established in 2009 vide Haryana Government Gazette Notification No. 29 of 2009, dated 16.9.2009 (Haryana Act No. 21 of 2009). Earlier, known as YMCA Institute of Engineering, Faridabad was founded in the year 1969 as a Joint Venture of Government of Haryana and National Council of YMCAs of India with active assistance from overseas agencies of West Germany to produce highly practical oriented personnel in specialized fields of engineering to meet specific technical manpower requirement of industries.

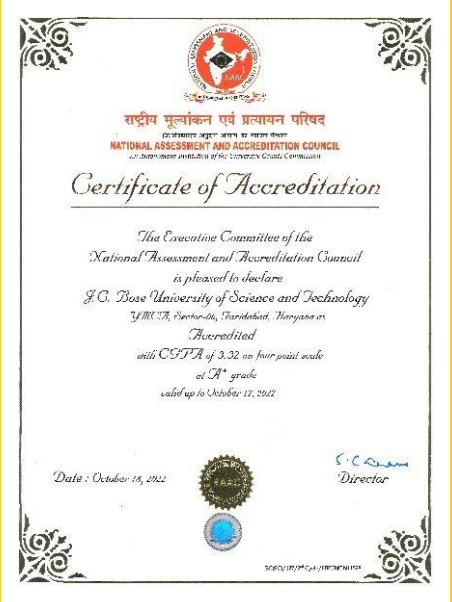
The University is well known for its track record of employment of the pass out students since its inception. The University has been recognized at various levels by the agencies including UGC, AICTE, NAAC, NBA and NIRF. The University offers B.Tech and M.Tech programs in core and specialized engineering disciplines. Also, Science, Management and Humanities programs are being offered by it, besides Ph. D. in numerous disciplines.

The University is situated right on the National Highway No.2 known as Mathura Road, 32 kms. from the Nation's Capital, New Delhi. The University has its own Campus on a plot area of 20 acres. It is located in the growing and sprawling Faridabad - Ballabgarh Industrial Complex of Haryana. The University is well connected with rail and road transport from Delhi / New Delhi.

AWARDS AND RECOGNITION

NAAC ACCREDITATION

J.C. Bose University has been re-accredited by the National Assessment and Accreditation Council (NAAC) with 'A+' Grade and a CGPA of 3.32 in the Second Cycle of Accreditation. NAAC, which is the highest body of evaluation for the Universities and Colleges in the country, assessed the University on seven point-scale criteria on quality parameters. The result of the assessment was declared in the 127th Meeting of the Standing Committee of NAAC held on October 18, 2022, and shall remain valid for the next five years.


राष्ट्रीय मूल्यांकन एवं प्रत्यायन परिषद
NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL
Certificate of Accreditation
The Executive Committee of the National Assessment and Accreditation Council is pleased to declare J.C. Bose University of Science and Technology YMCA, Sector-6A, Faridabad, Haryana as Accredited with CGPA of 3.32 on four point scale at A+ grade valid up to October 17, 2027
Date : October 18, 2022
Director

NBA ACCREDITATION

Undergraduate Programs are accredited by National Board of Accreditation (NBA) in 3rd cycle.

J.C. Bose University (YMCA) Faridabad was ranked top 15 institutions on SWAYAM-NPTEL Local Chapters, receiving the highest 'AAA' grade in the year 2024

NIRF RANKING

The University has maintained the tradition of its excellence in Technical Education. The University has consistently made its place in the top 150-200 Engineering Institutes ranking in the Countryin NIRF Rankings. The University aims to be among the top 100 institutions in the country. Apart fromthis, the University strives to make its presence in the University, Management, and Research categories of the Ranking.

ARIIA RANKING

The University has made its presence in the Atal Ranking of Institutions on Innovation Achievements (ARIIA) Rankings and it has been placed under 'Band-Performer' in the category of Govt. & Govt. Aided University and Deemed to be University (Technical)' in ARIIA Rankings 2021.

ARIIA Rankings is an initiative of the Ministry of Education (MoE), Government of India implemented through AICTE and MoE's Innovation Cell to systematically rank all major higher educational institutions and universities in India on indicators related to promotion and support of 'Innovation and Entrepreneurship Development' amongst students and faculties.

NPTEL RANKING

The University is consecutively rated in the top 100 institutions on SWAYAM-NPTEL Local Chapter among more than 4000 institutes across the Country.

IIC RATING

The University has been rated '4.5 Star' by Innovation Cell, Ministry of Education, Govt. of India to promote Innovation and Start-up for the year 2019-20.

DST PURSE GRANT

DST PURSE Grant 2022 for improvement of Science Infrastructure

AICTE'S LILAVATI AWARDS 2021-22

A five members' team of Prof. Lakhwinder Singh (Mechanical Engineering Department), Dr. Sapna Gambhir (Computer Engineering Department), Dr. Parul Tomar (Computer Engineering Department), Dr. Rashmi Chawla (Electronics Engineering Department), Ms. Khushi Gupta (Computer Engineering Department) has been awarded 1st Runner up position in AICTE's Lilavati Awards 2021-22 under Sub-Theme 'Women Innovators' (Rural/Urban).

AICTE'S BRAND AMBASSADOR OF CHANGE

All India Council for Technical Education (AICTE) has selected J.C. Bose University of Science and Technology, YMCA, Faridabad for AICTE's Brand Ambassador of Change under its Leadership in Teaching Excellence (LITE) Program for Academic Year 2021-22. Two faculty members namely Dr. Payal Gulati and Dr. Amita Arora, both Assistant Professors in Computer Engineering department have also been selected for Leadership Training under the Program.

EDUFUTURE EXCELLENCE AWARD-2022

The University has received the Edufuture Excellence Award-2022 for Excellence in Faculty and Management. The Award is given to acknowledge and applaud the efforts of educational leaders, institutions, teachers, and students who went beyond the mile and demonstrated excellence in the field of education.

TEQIP-III PROJECT

The University has successfully implemented the third phase of World Bank assisted Technical Education Quality Improvement Program (TEQIP-III) which was granted to the University in the year 2017.

RUSA SCHEME

The Ministry of Education, Government of India has selected the University in year 2018 to extend support under the RUSA 2.0, the second phase of Rashtriya Uchchatar Shiksha Abhiyan. The Scheme aims at providing strategic funding to eligible State Higher Educational Institutions.

CAREERS 360 RATING

The Careers 360 Magazine has ranked the University among top Engineering Institutions in Haryana in lastmany consecutive years. The University has been awarded with 'AAAA+' rating by Magazine.

ISO CERTIFICATION

The University has been awarded ISO Certification of Recognition for its Quality Management System that complies with the requirements of the standard ISO 9001:2015 and for its Environment Management System that complies to the requirements of the standard ISO 14001:2015.

RED CROSS STATE LEVEL AWARD

Indian Red Cross Society, Haryana State Branch awarded the University with 'Youth Red Cross Shield' and Coordinator – YRC with 'Youth Red Cross Award' for Voluntary Blood Donation (Educational Institution), for the year 2019-20 and the Vice Chancellor with Souvenir, for the year 2020-21.

AICTE – MARGDARSHAN SCHEME

The All India Council for Technical Education (AICTE) has granted J.C. Bose University of Science and Technology, YMCA, Faridabad the status of 'Mentor Institute' to support nearby Technical Institutes in achieving quality parameters like NBA Accreditation. The University will serve as the 'Mentor' (Margdarshan Institute) to guide and disseminate knowledge to 8 Technical Institutes under the Margdarshan Scheme of AICTE.

AICTE VISVESVARAYA BEST TEACHER AWARD 2021

Dr. Neelam Duhan, Associate Professor of the Department of Computer Engineering, J.C. Bose University of Science and Technology, YMCA, Faridabad, has been awarded the AICTE Visvesvaraya Best Teacher Award 2021.

APPRECIATION AWARD

Appreciation award by DC Faridabad - in the field of life saving Program for Blood Donation and COVID-19 Pandemic, between the years 2015 and 2021.

MEMBERSHIP

The University is a member of Association of Indian Universities (AIU) and Institutional Membership of Institution of Engineers

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD
(Formerly YMCA University of Science and Technology, Faridabad)
(NAAC Accredited 'A^{+}' Grade State Govt. University)
NH- 2, SECTOR-6, FARIDABAD-121006, HARYANA, INDIA

SCHEDULE FOR Ph.D. Admission in Session 2025-26
*KEY DATES

1. Availability of prospectus and online application on the University website: 01/10/2025
2. Last date for submission of online application forms duly filled in for admission at the University website: 03/11/2025
3. Availability of the list of candidates on the University website: 06/11/2025
4. Date of Entrance examination: 08/11/2025
5. Date of Interview & Counselling: 13/11/2025 to 14/11/2025
6. Display of the list of selected candidates for Ph.D. admission: 17/11/2025
7. Course fee submission by selected candidate: 18/11/2025 to 21/11/2025
8. Reporting to the respective departments: 24/11/2025
9. Date of Commencement of the Ph.D. course work classes: 12/01/2026

**University reserves the right to change these dates in view of uncertainties or any other unavoidable circumstances.*

NOTE:

Candidates are required to make the payment of Rs.1050/- (Rs. 525/- for SC /ST Category) via online payment gateway for application form/registration fee through Debit/Credit Card, Net Banking or by E-Challan.

The candidate without depositing the fee will not be considered for admission process

GENERAL INFORMATION

1. This prospectus/advertising is for the regular Ph.D. program (Full-Time & Part-Time mode) for 2025-26. The application form for admission would be available online on the university website: www.jcboseust.ac.in.
2. The duly completed online application form along with all required enclosures should be submitted by the last date as specified. No application will be entertained thereafter.
3. A candidate who furnishes particulars which are found to be false or suppresses material information will not be considered for admission, and if he/ she is admitted on such information, his/ her admission shall be cancelled as per the University rules, and all fees deposited by him/ her will stand forfeited.
4. Before accepting the admission, the candidate must also ensure that he/ she fulfills the minimum eligibility conditions. Fee once paid will not be refunded.
5. All the admitted candidates will be governed by the Academic Regulation and/or Ordinance as laid down by the University and amended from time to time.
6. In the case of any inconsistencies in the rules or any clarification thereof, the matter shall be referred to the competent authority for interpretation, whose decision shall be final.
7. Detailed ordinance is available at the university website.
8. The candidate who doesn’t deposit the application fee shall not be considered for the admission process.

INTRODUCTION

The Ph.D. program was started in the University in the year 2010. Till now more than 200 students of different batches are enrolled for Ph.D. programs in the disciplines of Mechanical Engineering, Electrical Engineering, Electronics Engineering, Computer Engineering, Management, Physics, Environmental Sciences, Chemistry, English Literature, Life Sciences, Civil Engineering and Mathematics.

FEE STRUCTURE

At the time of admission:

Candidates are required to pay their fees of **Rs. 25,000/-** at the time of admission by physically visiting the account branch of the University from 9:30 AM to 4:30 PM w.e.f 18.11.2025 to 21.11.2025.

Note: It is advised to collect the fee receipt from the Accounts Branch after depositing the fee.

Consolidated list of Ph.D. seats for the Session 2025-2026 offered at the University Campus

Sr. No.	Name of the Department	No. of Ph.D. seats	Area(s) in which Ph.D. is offered
1	Computer Engineering	70	Software Testing, Machine learning, AI, Image Processing, Machine Learning, Information Retrieval, Communication Networks, Algorithms, Web mining, Machine learning, Image processing, Multimodal learning , Machine learning, information retrieval, IoT, Wireless Network, Sensor Network, Security , software testing, machine learning , Wireless Security, Blockchain, Wireless Communication, Machine learning, Data Analytics, Biometrics, Wireless Sensor Networks, Machine Learning, Data Analytics , Machine learning, Blockchain, Mobile and Adhoc networks, Machine Learning, Security, Software Testing, Predictive Modeling, Machine Learning, Computer Vision, Machine learning, Data Analytics, AI, Computer Vision, Deep Learning, Image Processing, Data Analytics , soft computing , computer vision, Wireless Security, Blockchain, Wireless Communication, AI, Machine Learning, information security, Android security, Wireless Sensor Networks, Machine Learning, Blockchain, Machine Learning, Data Analytics, AI, Recommendation System, Online Marketing, Recommendation Engine
2	Computer Applications	30	Computer Vision, Machine Learning, Information Retival, Artificial Intelligence, Machine Learning, Web Technologies, Natural Language Processing, Computer Vision, Machine Learning, Information Retival, Artificial Intelligence & Fuzzy Logic, Information Retival, Machine Learning, Data Science, Big Data, Oncology, Software Testing, Machine Learning, Generative AI

3	Civil Engineering	05	Green Materials, Sustainable Infrastructure, Geo-Technical Engineering
4	Electrical Engineering	50	FACTS, Renewable Energy Systems, Power Quality, Power Electronics and Machine Drives, Control System. Power System, AI and Optimization Techniques, Control System. Power System, Power Quality, Renewable Energy Systems, Electric Vehicles, AGC/LFC of Power Systems, Microgrid Operation & Control, Renewable Energy Systems, AGC, Optimization, Electric Vehicles, Decentralized power generation , Renewable Energy Systems, Electric Vehicles, Power Electronics and Drives, Electrical machines and power electronics drive, control system, electric vehicle system, power system, Artificial intelligence and machine learning, non-linear controller design, power system generation, operation and protection control
5	Electronics Engineering	70	Semiconductor Device Modelling, Signal Processing and Channel Coding, Wireless Communication, Wireless Sensor Network, IoT, Signal Processing, Embedded Systems, Cryptograpgy steganography watermarking, VLSI DESIGN, Semiconductor Devices, AI in VLSI, Embedded system, IoT development and applications, smart electronics systems, photovoltaic system, Control System , IoT, Metamaterial, antenna & wave propagation, wireless communication, IOT, IoT and Sensors, wireless communication and image processing, Wireless Sensor Networks, Internet of Things and Wireless Communication, Control System, Electronics Communication, Signal processing, VLSI Design, VLSI, Devices and Nanoelectronic Circuits
6	Mechanical Engineering	70	Advance manufacturing, mechanical metallurgy, Manufacturing, Robotics, 3D printing, Materials, Production/Manufacturing, Advanced Manufacturing, Industrial Engineering, Design, CAE, Material Technology, Design, Advanced Manufacturing, Industrial Engineering, Data Science, Robotics, Smart materials, Production management, Industrial Engineering, Advanced Manufacturing, 3d printing, Computer Integrated Manufacturing, Materials, Biomass Energy, Industrial engineering, 3D printing, Latest Manufacturing Systems, 3D printing, AI in manufacturing
7	Management	30	Marketing & General Management, Finance, Marketing, Marketing & General Management, Finance, Human Resource Management, Finance, Management General, Human Resource Management
8	Communication and Media Technology	05	Communication Studies, Journalism & New Media, Digital Media & New Technologies, Global & Comparative Media Studies
9	Mathematics	25	Operations Research, Continuum Mechanics- Wave Propagation, Approximation theory, Quantum Optics and Quantum Information Processing, Continuum Mechanics, Applied Mathematics, Fixed Point Theory

10	Physics	25	Material Science, Nanotechnology
11	Chemistry	50	Organic Synthesis, Inorganic Chemistry, Corrosion Chemistry, Organic Synthesis and Medicinal Chemistry, Optical Spectroscopy/Physical Chemistry, Physical and Theoretical Chemistry, Inorganic Chemistry, Organic Chemistry
12	Environmental Sciences	15	Sustainable Water and Wastewater Treatment using Nanotechnology, Solid Waste Management and resource recovery, Wastewater Treatment, Environmental Nanotechnology
13	Life Sciences	30	Plant Biotechnology, Environmental Biotechnology and Industrial microbiology, Industrial and food microbiology, Recombinant therapeutics and protein folding, Environmental and Agricultural Microbiology, Industrial Microbiology/ Biotechnology, Agricultural Microbiology and Plant Microbes interactions, Environmental Microbiology, Agricultural Biotechnology & Molecular Biology, Industrial biotechnology, Probiotics, Mucins
	Total seats	**475**	

Note:

(i) The number of Ph.D. seats may increase or decrease in any of the above mentioned departments.

(ii) The broad areas of specialization mentioned against each of the departments above ismerely for the information of the candidates that research supervisor(s) are available in these areas. However, admission to Pre-Ph.D. course will be strictly as perprocedure laid down in Ordinance of Doctor of Philosophy.

(iii) The university may not fill available seats in case candidate's specialization/choice does not match with the requirement or suitability.

(iv) Merely being eligible for the interview and facing it does not entitle the candidate for Ph.D. admission. Based on the performance in the interview a candidate may be reported as 'Not Found Suitable' and hence may not get selected.

Seat Matrix PHD for Session 2025-26

S.No.	Department	A		B			C							D							E							F							G							H			I
		Total Intake	Intake (Excluding EWS)	Total ROHC	RoHC		Total HOGC	HOGC						Total SC+SCD	Total SC	SC					Total SCD	SC-D						Total BCA	BC-A						Total BCB	BC-B						Total PH	PH		HoGC - EWS
					O	F		O	F	ESM		FF				O	F	ESM		FF		O	F	ESM		FF			O	F	ESM		FF			O	F	ESM		FF					
										O	F	O	F					O	F	O	F			O	F	O	F				O	F	O	F				O	F	O	F				
1	Mechanical Engg	70	64	10	8	2	27	19	7			1		11	5	4	1				6	4	1		1			9	6	3					6	5	1					1	1		6
2	Computer Engg	70	64	9	7	2	27	19	7	1				11	6	4	2				5	4	1					9	7	2					6	4	1			1		2	1	1	6
3	Electrical Engg	50	45	7	5	2	19	14	5					8	4	2	1			1	4	3	1					6	5	1					4	3	1					1	1		5
4	Electronics Engg	70	64	9	7	2	27	20	6		1			11	6	4	2				5	4	1					9	7	2					6	5	1					2	1	1	6
5	Management Studies	30	27	4	3	1	12	8	3			1		4	2	1	1				2	2						3	2	1					3	2	1					1	1		3
6	Mathematics	25	23	4	3	1	10	8	2					4	2	2					2	1	1					3	2	1					2	1	1								2
7	Physics	25	23	3	2	1	10	8	2					4	2	2					2	1	1					3	2	1					2	1			1			1	1		2
8	Chemistry	50	45	7	5	2	19	13	5			1		8	4	3	1				4	3	1					6	5	1					4	3	1					1	1		5
9	Environmental Sciences	15	14	2	1	1	6	5	1					2	1	1					1	1						2	1	1					1	1						1	1		1
10	Communication and Media Technology	5	4	1	1		2	1	1					1							1	1							0																1
11	Computer Application	30	27	4	3	1	12	8	3	1				4	2	2					2	1	1					4	3	1					3	2	1								3
12	Life Sciences	30	27	4	3	1	11	9	2					4	2	1	1				2	2						4	3	1					3	1	1	1				1		1	3
13	Civil Engineering	5	5	1	1		2	1	1					1	1	1												1	1															
Total		475	432	65	49	16	184	133	45	2	1	3	0	73	37	27	9	0	0	1	0	36	27	8	0	1	0	0	59	44	15	0	0	0	0	40	28	9	1	1	1	0	11	8	3	43

- **NOTE: 25% horizontal reservation in all categories in all courses shall be provided for Female candidates**
- **Reservation of seats in BC-A & BC-B categories under ESM & FF sub-categories are given in only BC-B Category for the session 2025-26 on rotation basis.**
- **NOTE: Seat Matrix has been prepared after excuding the EWS Category seats from the Intake i.e. (A-I)**

Rest of Haryana Category = ROHC
Haryana Open General Category = H
Schedule Castes = SC
Deprived Schedule Castes = SD-D
Backward Classes (A) = BC-A
Backward Classes (B) = BC-B

Physically Handicapped = PH
Open = O
Female = F
Ex-Serviceman = ESM
Freedom Fighter = FF
Economically Weaker Sections= EWS

Eligibility

1. A 1-year / 2-semester master's degree Program after a 4-year / 8-semester bachelor's degree Program or a 2-year / 4-semester master's degree Program after a 3-year bachelor's degree Program or qualifications declared equivalent to the master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade in a point scale wherever grading system is followed or equivalent qualification from a foreign educational institution accredited by an assessment and accreditation agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of the educational institution. The equivalence of the degree will be decided by the Board of Studies (BOS) of the concerned department in the University.
2. A relaxation of 5% marks or its equivalent grade may be allowed for those belonging to SC/ST/OBC (non-creamy layer) / Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per the decision of the Commission from time to time.
3. Provided that a candidate seeking admission after a 4-year / 8-semester bachelor's degree Program should have a minimum of 75% marks in aggregate or its equivalent grade on a point scale wherever the grading system is followed. A relaxation of 5% marks or its equivalent grade may be allowed for those belonging to SC / ST / OBC (non-creamy layer) / Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per the decision of the Commission from time to time.
4. Candidates who have completed the M.Phil. Program with at least 55% marks in aggregate or its equivalent grade in a point scale wherever grading system is followed or equivalent qualification from a foreign educational institution accredited by an assessment and accreditation agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of educational institutions, shall be eligible for admission to the Ph.D. Program. A relaxation of 5% marks or its equivalent grade may be allowed for those belonging to SC / ST / OBC (non-creamy layer) / Differently-Abled, Economically Weaker Section (EWS)

and other categories of candidates as per the decision of the Commission from time to time.

5. The candidates who appeared in the regular master's level examination in the current session may also appear in the entrance test. But they must submit proof of having passed the examination on the pre-designated date before admission to the Pre-Ph.D. course.
6. The state reservation policy shall be followed in Ph.D. Admission.
7. A candidate provisionally registered for Ph.D. shall be required to attend classes for one semester for a Pre-Ph.D. course work.
8. The candidates who are awarded a fellowship by the University / outside agency to carry out Ph.D. work, shall be required to stay at the University headquarter for the whole duration of the fellowship. The Chairperson of the department concerned will certify the stay of the candidate. These candidates will be registered in full-time mode and perform the duties & other assignments as per the norms of the scholarship awarding body.

Procedure for Admission

The admission shall be based on the criteria notified by the University, keeping in view the guidelines/norms in this regard issued by the UGC and other statutory/regulatory bodies concerned, and taking into account the reservation policy of the Haryana State Government from time to time.

- Admission to the Ph.D. program shall be made using the following methods:

I. The University will admit students who qualify for fellowship/scholarship in UGC-NET(Category1,2,3)/UGC- CSIR NET/GATE and similar National level tests.

Or

II. The University will admit students through an Entrance Test. The Entrance Test syllabus consists of 50% of research methodology (Section -A), and 50% of a specific subject (Section -B).

(The syllabus for the entrance examination in respective departments is attached as Annexure - I)

The merit list for admission and allotment of scholarship shall be prepared by the

department according to the following criteria (UGC notification No.F.4-1(UGC-NET Review Committee)/ 2024 (NET}/40648 dated March 27, 2024

- 70% marks based on performance in NET/GATE/other valid and qualifying National Level Test/ University entrance test
- 30% marks based on performance in the interview/viva-voce to be conducted by the respective department.

The merit list for admission and allotment of scholarship shall be prepared by the department according to the following criteria:

For Sciences/Management/Humanities/: -

a. 70% marks from the entrance*/70% marks to the candidates exempted from the entrance.
b. 5% marks of the percentage of marks in the Master's degree M.Sc./MBA/M.Com/M.A.
c. 15% marks in the interview to be conducted by the respective Department.
d. 5% marks for work experience (01 marks per year for experience subject to max.5 marks).
e. 5% marks (01 marks for each publication in UGC approved list of Journals subjected to max.5 marks)

For Engineering & Technology/Computer Applications :-

a. 70% marks from the entrance*/70% marks to the candidates exempted from entrance.
b. 5% marks of the percentage of marks in the MCA/M.Tech.
c. 15% marks in the interview to be conducted by the respective Department.
d. 5% marks for work experience (01 mark per year for experience subject to max.5 marks).
e. 5% marks (01 marks for each publication in UGC approved list of Journals subjected to max.5 marks)

Where CGPA is awarded and percentage of marks is not mentioned,

Percentage of marks = 9.5 x CGPA

*These marks are calculated on the percentile basis i.e. candidate having maximum marks in the entrance will be given 70 marks.

The LIST OF SUCCESSFUL APPLICANTS will be displayed on university website and notice boards. **The successful applicants will report to the Chairperson of the respective teaching department on the scheduled date for interview/Admission**.

The Ph.D. will have the following categories of scholars admitted to the program

1. A research scholar getting scholarship (URS) from the University.
2. A research scholar receiving fellowship / scholarship from outside organizations such as CSIR, UGC, QIP, DST, AICTE etc.
3. A research scholar receiving fellowship / scholarship under MoU between University and industry.
4. A scholar who does not receive financial help like scholarship/assistant ship from university or from any other source during his/her Ph.D. program.
5. Industry - sponsored candidates

(Guidelines for Part-Time/Full-Time/Industry-sponsored candidates are attached at annexure- II)

- **Research Scholarship from University**

1. Four University Research Scholarships (URS) of Rs. 25000/- each will be awarded as per rules of the University.
2. One MOB research fellowship (MRF) of Rs.31,000/- + HRA will be awarded to engineering stream only as per rules of the University.

* For the details of the URS/MRF scholarships please refer the University Website**.**

- **Leave**

I. Leave for a maximum of 15 days in a year in addition to general

holidays may be allowed to a Research Scholar by the Chairperson of the Department on the recommendation of the Supervisor. The scholar will not be entitled to any vacations. No other leave of any kind with scholarship will be admissible to a Research Scholar.

II. Leaves are admissible to all scholarship receiving candidates as per rules of the scholarship awarding agency.

Note:

1. Very limited hostel facilities are available for girls (subject to availability)
2. No hostel facilities for boys
3. Students are expected/encouraged to work on multidisciplinary, industry and society relevant problems

(Ph.D. ordinance to be followed for everything not mentioned here.)

Annexure – I

SYLLABUS FOR Ph.D. ENTRANCE-2025-26

Section-A (Compulsory for all Ph.D. Program)

RESEARCH METHODOLOGY

Unit I

Meaning of Research, Research Process and Scope of Research in various disciplines, Scientific methods of research, selecting a topic of research, Ethics in Research, Different research designs and their role

Unit II

Sampling Design, Measurement and scaling techniques, Methods of data collection – questionnaire/schedule; questionnaire designing, interview and observational Methods, Primary and Secondary sources of data collection, Data Preparation, Editing, coding, tabulation, graphic and diagrammatic presentation of data

Unit III

Formulation of Hypothesis Concept; Test of Hypothesis, Parametric tests and non-parametric test (chi-square test), Analysis of variance (one way classification)

Unit IV

Multivariate Analysis Techniques: Factor Analysis; Multiple Regression; Correlation Analysis, Cluster analysis, Discrimination Analysis and Conjoint Analysis, Style and Major Ingredients of a report format

1. DEPARTMENT OF MECHANICAL ENGINEERING

Section- B

Unit I Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange’s equation.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr’s circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler’s theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and

governors; balancing of reciprocating and rotating masses; gyroscope.
Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.
Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.
Unit II Fluid Mechanics and Thermal Sciences
Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings; basics of compressible fluid flow.
Heat Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis
Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.
Applications: Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and dual cycles.
Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.
Unit III Materials, Manufacturing and Industrial Engineering
Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.
Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.
Machining and Machine Tool Operations: Mechanics of machining; basic machine tools;

single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.
Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM).
Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools; additive manufacturing.
Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.
Inventory Control: Deterministic models; safety stock inventory control systems.
Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

2. DEPARTMENT OF COMPUTER ENGINEERING

Section- B

SECTION 1: ENGINEERING MATHEMATICS
Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, colouring. Combinatorics: counting, recurrence relations, generating functions.
Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
Calculus: Limits, continuity and differentiability, Maxima and minima, Mean value theorem, Integration.
Probability and Statistics: Random variables, Uniform, normal, exponential, Poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.
SECTION 2: DIGITAL LOGIC
Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).
SECTION 3: COMPUTER ORGANIZATION AND ARCHITECTURE
Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).
SECTION 4: PROGRAMMING AND DATA STRUCTURES
Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
SECTION 5: ALGORITHMS
Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer.

Graph traversals, minimum spanning trees, shortest paths.

SECTION 6: THEORY OF COMPUTATION

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

SECTION 7: COMPILER DESIGN

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimization, Data flow analyses: constant propagation, liveness analysis, common sub expression elimination.

SECTION 8: OPERATING SYSTEM

System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.

SECTION 9: DATABASES

ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

SECTION 10: COMPUTER NETWORKS

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

3. DEPARTMENT OF CIVIL ENGINEERING

Section- B

Structural Engineering- Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Friction and its applications; Kinematics of point mass and rigid body; Centre of mass; Euler’s equations of motion; Impulse-momentum; Energy methods; Principles of virtual work. Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Theories of failures; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, buckling of column, combined and direct bending stresses. Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis. Construction Materials and Management: Construction Materials: Structural steel - composition, material properties and behaviour; Concrete -

constituents, mix design, short-term and long-term properties; Bricks and mortar; Timber; Bitumen. Construction Management: Types of construction projects; Tendering and construction contracts; Rate analysis and standard specifications; Cost estimation; Project planning and network analysis - PERT and CPM. Concrete Structures: Working stress, Limit state and Ultimate load design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete; Analysis of beam sections at transfer and service loads. Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Plastic analysis of beams and frames.

Geotechnical Engineering - Soil Mechanics: Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Unified and 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; Onedimensional consolidation, time rate of consolidation; Mohr's circle, stress paths, effective and total shear strength parameters, characteristics of clays and sand. Foundation Engineering: 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 and Meyerhoff's bearing capacity theories, 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.

Water Resources - Engineering Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum, energy and corresponding equations; Potential flow, applications of momentum and energy equations; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth. Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Kinematics of flow, velocity triangles; Basics of hydraulic machines, specific speed of pumps and turbines; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, slope profile, hydraulic jump, uniform flow and gradually varied flow Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, flood estimation and routing, reservoir capacity, reservoir and channel routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's law. Irrigation: Duty, delta, estimation of evapo-transpiration; Crop water requirements; Design of lined and unlined canals, head works, gravity dams and spillways; Design of weirs on permeable foundation; Types of irrigation systems, irrigation methods; Water logging and drainage; Canal regulatory works, cross-drainage

structures, outlets and escapes.

Environmental Engineering - Water and Waste Water: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal. Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits. Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal). Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

Transportation Engineering - Transportation Infrastructure: Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments; Geometric design of railway track; Airport runway length, taxiway and exit taxiway design. Highway Pavements: Highway materials - desirable properties and quality control tests; Design of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2012; Design of rigid pavements using IRC: 58-2011; Distresses in concrete pavements. Traffic Engineering: Traffic studies on flow, speed, travel time - delay and O- D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster’s method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads.

Geomatics Engineering - Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry - scale, flying height; Remote sensing - basics, platform and sensors, visual image interpretation; Basics of Geographical information system (GIS) and Geographical Positioning system (GPS).

4. DEPARTMENT OF ELECTRONICS ENGINEERING

Section- B

Section 1: Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

Differential Equations: First order (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's, Stokes' theorems.

Complex Analysis: Analytic functions, Cauchy's integral theorem and formula, sequences, series, convergence tests, Taylor and Laurent series, residue theorem.

Probability & Statistics: Mean, median, mode, standard deviation, combinatorial probability, probability distributions (binomial, Poisson, exponential, normal), joint and conditional probability.

Section 2: Networks, Signals and Systems

Circuit analysis: Node and mesh analysis, superposition, Thevenin's, Norton's, reciprocity theorems. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform.

Linear 2-port network parameters, wye-delta transformation.

Continuous-time signals: Fourier series and transform, sampling theorem and applications.

Discrete-time signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals. LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

Section 3: Electronic Devices

Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors.

Carrier transport: Diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations.

P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell.

Section 4: Analog Circuits

Diode circuits: Clipping, Clamping and rectifiers.

BJT and MOSFET amplifiers: Biasing, AC coupling, small-signal analysis, frequency response, current mirrors, differential amps.

Op-amp Circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt

triggers and oscillators.

Section 5: Digital Circuits

Number representations: Binary, integer and floating-point- numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders.

Sequential Circuits: Latches and flip-flops, counters, shift registers, Finite State Machines, propagation delay, setup and hold time, critical path delay.

Data converters: Sample and hold circuits, ADCs and DACs.

Semiconductor Memories: ROM, SRAM, DRAM.

Computer organization: Machine instructions, addressing modes, ALU, data-path and control unit, instruction pipelining.

Section 6: Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Section 7: Communications

Random processes: Auto correlation and power spectral density, properties of white noise, filtering of random signals through LTI systems.

Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers.

Information theory: Entropy, mutual information, channel capacity theorem.

Digital Communication: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

Section 8: Electromagnetics

Maxwell’s equations: Differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector.

Plane waves: Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

Transmission lines: Equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.

5. DEPARTMENT OF ELECTRICAL ENGINEERING

Section- B

Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigen values, Eigen vectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis.

Electric circuits

Network elements: ideal voltage and current sources, dependent sources, R, L, C, M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; Transient response of dc and ac networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits.

Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric

field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Signals and Systems

Representation of continuous and discrete time signals, shifting and scaling properties, linear time invariant and causal systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform. R.M.S. value, average value calculation for any general periodic waveform

Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion

principles; DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines

Power Systems

Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines and cables, Economic Load Dispatch (with and without considering transmission losses), Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per- unit quantities, Bus admittance matrix, Gauss- Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Control Systems

Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady- state analysis of linear time invariant systems, Stability analysis using Routh- Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, Solution of state equations of LTI systems

Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Active Filters: Sallen Key, Butterwoth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

Power Electronics

Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three- phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation.

Nuclear radii and charge distributions, nuclear binding energy, electric and magnetic

moments; semi-empirical mass formula; nuclear models; liquid drop model, nuclear shell model; nuclear force and two nucleon problem; alpha decay, beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclear reactions, conservation laws; fission and fusion; particle accelerators and detectors; elementary particles; photons, baryons, mesons and leptons; quark model; conservation laws, isospin symmetry, charge conjugation, parity and time-reversal invariance.

6. DEPARTMENT OF MANAGEMENT STUDIES

Section- B

Unit-I

Managerial Economics-Demand Analysis; Production Function; Cost-output relations; Market structures; Pricing theories; Advertising; Macro-economics; National Income concepts; Infrastructure-Management and Policy; Business Environment; Capital Budgeting

Unit-II

The concept and significance of organisational behavior—Skills and roles in an organisation-Classical, Neo-classical and modem theories of organisational structure—Organisational design—Understanding and Managing individual behaviour personality— Perception—Values—Attitudes—Learning-Motivation.

Understanding and managing group behavior, Processes—Inter-personal and group dynamics—Communication—Leadership—Managing change—Managing conflicts.

Organisational development.

Unit-III

Concepts and perspectives in HRM; HRM in changing environment; Human resource planning—Objectives, Process and Techniques; Job analysis—Job description; Selecting human resources; Induction, Training and Development; Exit policy and implications; Performance appraisal and evaluation; Potential assessment; Job evaluation; Wage determination; Industrial Relations and Trade Unions; Dispute resolution and Grievance management; Labour Welfare and Social security measures

Unit-IV

Financial management—Nature and Scope; Valuation concepts and valuation of securities; Capital budgeting decisions—Risk analysis; Capital structure and Cost of capital; Dividend policy—Determinants; Long-term and short-term financing instruments; Mergers and Acquisitions

Unit-V

Marketing environment and Environment scanning; Marketing Information Systems and Marketing research; Understanding consumer and industrial markets; Demand Measurement and Forecasting; Market Segmentation—Targeting and Positioning; Product decisions, Product mix.

Product Life Cycle; New product development; Branding and Packaging; Pricing methods and strategies.

Promotion decisions—Promotion mix; Advertising; Personal selling; Channel

management; Vertical marketing systems; Evaluation and control of marketing effort; Marketing of services; Customer relation management;
Uses of internet as a marketing medium—other related issues like branding, market development, Advertising and retailing on the net.
New issues in Marketing.
Unit-VI
Role and scope of production management; Facility location: Layout planning and analysis: Production planning and control—production process analysis; Demand forecasting for operations; Determinants of product mix; Production scheduling; Work measurement; Time and motion study; Statistical Quality Control.
Role and scope of Operations Research; Linear Programming: Sensitivity analysis; Duality; Transportation model; Inventory control; Queueing theory; Decision theory; Markov analysis; PERT/CPM.
Unit-VII
Probability theory; Probability distributions-Binomial, Poisson, Normal and Exponential; Correlation and Regression analysis; Sampling theory; Sampling distributions; Tests of Hypothesis; Large and small samples; t, z, F, Chi-square tests.
Use of Computers in Managerial applications; Technology issues and Data processing in organizations; Information systems; MIS and Decision making; System analysis and design; Trends in Information Technology; Internet and Internet-based applications.
Unit-VIII
Concept of corporate strategy; Components of strategy formulation; Ansoff's growth vector; BCG Model; Porter's generic strategies; Competitor analysis; Strategic dimensions and group mapping; Industry analysis; Strategies in industry evolution, fragmentation, maturity, and decline; Competitive strategy and corporate strategy; Transnationalization of world economy; Managing cultural diversity; Global Entry strategies; Globalisation of financial system and services; Managing international business; Competitive advantage of nations; RTP and WTO.
Unit-IX
Concepts—Types, Characteristics; Motivation; Competencies and its development; Innovation and Entrepreneurship; Small business—Concepts, Government policy for promotion of small and tiny enterprises; Process of business opportunity identification; Detailed business plan preparation; Managing small enterprises; Planning for growth; Sickness in Small Enterprises; Rehabilitation of sick enterprises: lntrapreneurship (organisational entrepreneurship).

7. DEPARTMENT OF ENVIRONMENTAL SCIENCE

Section- B

Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.

Natural resources, conservation and sustainable development · Chemical compositions of Air: Classification of elements, Particles, Ions and radicals in atmosphere, chemical processes for formation of inorganic and organic particulate matter, thermo-chemical and photochemical reaction in atmosphere, Oxygen and Ozone chemistry, chemistry of air pollutants , photochemical smog

Water Chemistry: Chemistry of water, Concept of DO, BOD, COD. · Soil Chemistry: Inorganic and organic components of soil, Nitrogen pathways and NPK in soils

Toxic Chemicals in the environment- Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, Ozone and PAN, pesticides, insecticides and carcinogens. · Ecosystem: Structure and functions, Abiotic and biotic components, energy flows, food chains, Food web, Ecological pyramids, types and diversity; Ecological succession, population, community ecology ad Parasitism, Prey predator relationships

Common Flora and fauna in India; Endangered and Threatened Species · Biodiversity and its conservation: definition, Hotspots of biodiversity, Strategies for biodiversity conservation, National parks and Sanctuaries, gene pool · Earth Process and Geological hazards, including floods, landslide, earthquakes, volcanism and avalanche.

Mineral Resources and environment; Trace elements and health, Epidemiological issues (Goitre, Fluorosis and Arsenic)

Principles of remote sensing and its application of environmental science; Application of GIS in environmental Management

Non-conventional sources of energy: Hydroelectric power, tidal, Ocean thermal energy conversion, Wind, Geothermal energy, Solar collector, Photovoltaic, solar pond, nuclear energy-Fission and fusion, Bio-energy from biomass and biogas, Anaerobic digestion, energy use pattern in different parts of the World; Environmental implication of energy uses. Fossil fuels.

AIR: Natural and anthropogenic source of pollution, Primary and Secondary pollutants, Methods of monitoring and control of air pollution SO_2, NOx, CO, SPM, effects of pollutant on human beings, plants, animals, material and on climate, Acid rain, Air Quality standards; Vehicular pollution

Global environmental problems-Ozone depletion, global warming and climatic change

Water: types, Sources and consequences of water pollution, Physico-chemical and Bacteriological sampling and analysis of water quality, Sewage waste water treatment and recycling .Water quality standards; Eutrophication and restoration of Indian lakes; Rain water harvesting

Soil: Physico-chemical and Bacteriological sampling as analysis of soil quality, Soil pollution control, Desertification and it's control; Wet lands conservation · Noise: Sources of noise pollution Measurements of noise and indices, Noise exposure levels and Standards. impact of noise on human health · Marine pollution and control, Radioactive and thermal Pollution · Impact Assessment Methodologies; Guidelines for Environmental Audit · Concept and strategies of sustainable development; Environmental priorities in India and Sustainable development

Sources and generation of solid waste, their characteristics, chemical composition and classification, Different methods of disposal and management of solid waste (Hospital Waste and Hazardous waste) recycling of waste material. Waste minimization

technologies

8. DEPARTMENT OF COMMUNICATION AND MEDIA TECHNOLOGY

Section- B

Introduction to Journalism and Mass Communication
Concept of Journalism and mass communication, mass communication in India.

History, growth and development of print and electronic media. Major landmarks in print and electronic media in Indian languages. Media's role in formulation of states of India. Media criticism and media literacy, Press Council and Press Commissions of India, status of journalism and media education in India. Media policies of the Government of India since Independence.
Models and theories of mass communication, normative theories, administrative and critical traditions in communication, media and journalism studies, communication and theories of socio-cultural, educational and agricultural change. Technological determinism, critique of Marshall McLuhan's views on media and communication and Marxist approaches. Information and knowledge societies.
Indian traditions and approaches to communication from the Vedic era to the 21st century. Western and Eastern philosophical, ethical and aesthetic perceptions of communication - Aristotle and Plato, Hindu, Buddhist, and Islamic traditions.
Media and culture - framework for understanding culture in a globalised world. Globalisation with respect to politico-economic & socio-cultural developments in India.
Communication for Development and Social Change
Concept and definition of development communication, role of media and journalism in society, characteristics of Indian society – demographic and sociological impact of communication, media and journalism. Media and specific audiences.

Development and social change. Issues and post-colonial conceptions.
Deconstruction of dominant paradigm of communication and development. Responses and critique of dominant models.
Corporatisation of development - Corporate Social Responsibility, non-state actors in development, mass campaigns by NGOs, Government of India, international agencies and corporates. Paradigms and discourse of development communication.
Emergence of global civil societies, public sphere, global communication system - nation state-universal, national communication policies.
Leading influencers of social reform in India - Raja Rammohan Roy, Pandit Madanmohan Malviya, Bal Gangadhar Tilak, Mahatma Jyotiba Phule, Mahatma Gandhi, Acharya Vinoba Bhave, Dr B. R. Ambedkar, Deendayal Upadhyay, Dr Ram Manohar Lohia etc.

Reporting and Editing
News-concepts, determinants (values), structure and perspectives. Reporting for print,

radio, television and digital media. Types of reporting. National and international news agencies and feature syndicates, functions and role.
Writing for print, electronic and digital news media. Translation and transcreation.
Editing and presentation techniques for print, television and digital media.
Journalism as profession, reportage of contemporary issues, ethics of reporting.
Critique of western news values, effect of new technology on global communication flows.
Niche Reporting.
Advertising and Marketing Communication
Definition, concept, functions, types, evolution of advertising, standards and ethics in advertising. Theories and models of communication in advertising.
Brand management.
Advertising management - agency-role, structure and function, client-agency relationship, media planning and budgeting.
Advertising and creativity, language and translation.
Advertising campaign and marketing.
Advertising and marketing research.

Public Relations and Corporate Communication
Public Relations and Corporate Communication - definition, concept and scope.
Structure of PR in State, Public, Private and non-government sectors.
Tools and techniques of PR and Corporate Communication.
Crisis communication and crisis communication management.
Ethics of Public Relations.
International Public Relations, communication audit.

Media Laws and Ethics
Concept of law and ethics in India and rest of the world.
The Constitution of India, historical evolution, relevance.
Concept of freedom of speech and expression in Indian Constitution.
Defamation, Libel, Slander-IPC 499-502, Sedition IPC 124(A), Contempt of Courts Act 1971, Official Secrets Act 1923, Press and Registration of Books Act 1867, Working Journalists and other Newspaper Employees (Conditions of Service) and Miscellaneous Provisions Act 1955, Wage Boards, Law of Obscenity (Section 292-294 of IPC); the Miller test, the Hicklin test, Indecent Representation of Women (Prohibition) Act 1986, Scheduled Castes and Tribes (Prevention of Atrocities) Act, 1989, Parliamentary Privileges. Famous cases involving journalists and news media organisations.

Right to Information Act 2005, Copyright Act 1957, Intellectual Property Rights, Cable Television Network (Regulation) Act 1995, Information Technology Act (relevant) 2000 and cyber laws, Cinematograph Act 1952, Film Censorship, Press Council Act as amended from time to time, IPR, ASCI, Drugs and Magic Remedies (Objectionable Advertisements) Act, 1954, Various regulatory bodies for print, TV, Advertising, PR, and Internet.

Rules, regulations and guidelines for the media as recommended by Press Council of India, Information and Broadcasting ministry and other professional organisations, adversarial role of the media, human rights and media.
Media Management and Production
Definition, concept of media management. Grammar of electronic media.

Communication design theories and practice.
Media production techniques – print and electronic.
Digital media production techniques.
Economics and commerce of mass media in India.
Principles and management in media industry post liberalisation.

ICT and Media
ICT and media - definition, characteristics and role. Effect of computer mediated communication. Impact of ICT on mass media. Digitisation.
Social networking.
Economics and commerce of web enabled media.

Mobile adaption and new generation telephony by media, ethics and new media.
ICT in education and development in India, online media and e-governance.

Animation - concepts and techniques.
Film and Visual Communication
Film and television theory.
Film and identity in Indian film studies, leading film directors of India before and after Independence. Indian cinema in the 21st century.
Approaches to analysis of Indian television.
Visual Communication. Visual analysis.
Basics of film language and aesthetics, the dominant film paradigm, evolution of Indian cinema-commercial and 'non-commercial' genres, the Hindi film song, Indian aesthetics and poetics (the theory of Rasa and Dhvani).
National cinema movements: Soviet Montage cinema, German Expressionistic cinema, Italian Neo-Realistic cinema, French New Wave cinema, British New Wave cinema, Indian New Wave cinema, Period cinema. Cinema in the new millennium.
Communication Research
Definition, concept, constructs and approaches to communication research process.
Research Designs - types, structure, components, classical, experimental and quasi experimental, variables and hypotheses; types and methods of research; basic, applied, descriptive, analytical, historical, case study, longitudinal studies.
Research in journalism, Public Relations, advertising, cinema, animation and graphics, television, Internet, social media practices, magazines, children's media. Communication, journalism and media research in India.
Levels of measurement: sampling-probability and non-probability, tests of validity and reliability, scaling techniques. Methods and tools of data collection-interviews, surveys,

case studies, obtrusive and non-obtrusive techniques, ethnography, schedule, questionnaire, dairy, and internet based tools, media specific methods such as exit polls, opinion polls, telephone, SMS surveys and voting with regard to GEC (general entertainment content).
Data analysis, testing, interpretation, application of statistical tests-parametric and non-parametric, tests of variance-univariate, bivariate and multivariate, tests of significance, computer mediated research.
Ethical considerations in communication, media and journalism research, writing research reports, plagiarism.

9. DEPARTMENT OF LIFE SCIENCES (PH.D. MICROBIOLOGY)

Section- B

Unit-1: History of microbiology with special reference to contributions of A.V. Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Sergei Beijerinck, Winogradsky, Alexander Fleming, Joseph Lister and Paul Ehrlich, Introduction to microbial taxonomy: brief outline classification of eubacteria, archaea, fungi and protists; classical and molecular approaches in microbial taxonomy. Structure and morphology of eubacterial and archaeal cells. Structure and morphology of fungal cell

Unit-2: Nutrition: requirements, categories, uptake and media, Growth: bacterial growth curve and mathematical model, isolation and maintenance of pure culture, factors affecting growth, measurement of growth, Reproduction in bacteria with emphasis on binary fission and budding; different strategies of reproduction in fungi, Sterilization techniques, disinfection and antisepsis. Mode of action of antibiotics, MIC assay, factors affecting antimicrobial action, Host pathogen interaction, types of toxins and their mode of action

Unit-3: Genome organization, Cell cycle: The eukaryotic cell cycle, Regulators of cell cycle progression, events of M phase, cytokinesis, Meiosis, Cell signaling: GPCR and role of second messenger (cAMP), Receptor protein tyrosine kinase, regulation of blood glucose level, calcium as an intracellular messenger, Apoptosis (Programd Cell Death), brief idea of cancer (p53 and pRb).

Unit-4: Growth: bacterial growth curve and mathematical model, isolation and maintenance of pure culture, factors affecting growth, measurement of growth, Reproduction in bacteria with emphasis on binary fission and budding; different strategies of reproduction in fungi

Unit-5: Strain Improvement and Microbial Growth Kinetics: Screening for new metabolites - primary and secondary metabolites. Strain development through selection, mutation, genetic recombination and metabolic engineering methods, Maintenance &

preservation of industrially important microorganisms using metabolic active and in-active methods, Stock cultures – primary & working stock cultures, Microbial growth and death kinetics, Batch, Fed-batch, Synchronous and Continuous bioprocess (Chemostat and Turbidostat), yield coefficient, doubling time, specific growth rate, metabolic and biomass productivities.

Unit-6: Bioreactor Design and Control: Introduction to Bioreactor, Design of a typical bioreactor (CSTR, Airlift, Packed bed, Photobioreactor), Different components of Bioreactors (peripherals and accessories such as pH, dissolved oxygen, temperature, foam, gas exchange sensors, biomass probe, aeration and agitation, and cooling components), modifications in design for plant and animal cell cultures, computational and remote control (SCADA and other data logging and analysis software's), bioprocess automation and application of computers in bioprocessing

Unit-7: Cells and organs of immune system. Primary, secondary and tertiary lymphoid organs. Types of immunity - Innate and adaptive, Humoral and cell-mediated, Active and passive. Pathogen associated molecular pathway: Toll like receptor, Clonal selection theory. Immunological memory, Antigens and immunogens, B and T cell epitopes; Haptens. Structure and functions of antibodies. Classes of immunoglobulins. CDRs, Valence, affinity and avidity. Antibody variants - Isotypes, Allotypes and Idiotypes.

Unit-8: Functional Foods & Single Cell Products: Probiotics (strain selection & mass productions), Food yeast (Biomass production & by-products), encapsulation of food components, apple cider productions, Kombucha fermentations, single cell products; algal, myco-protein based, Bio-fortified foods (rice & oil crops), Food for special dietary uses (mineral enriched products.

Unit-9: Waste water treatment: sources, characterization, primary, secondary (aerobic and anaerobic) and tertiary treatment, Water quality assessment, bioindicators, Solid waste treatment : sources, treatment strategies (landfills, composting, vermicomposting) Radioactive waste characterization and disposal. Microbially enhanced oil recovery (MEOR), biomineralization, bioplastics

Unit-10: Concept of pathogenicity and virulence, microbial adherence, spreading and establishment of pathogens, Biofilm mediated infection, Epidemiology of infection, Microbial Toxins (Bacterial Toxins, distinguishing feature of Endotoxins and exotoxins, Mycotoxins), Antimicrobial agents- classification, susceptibility and resistance.

10. DEPARTMENT OF LIFE SCIENCES (PH.D. BIOTECHNOLOGY)

Section- B

Unit-1: Genome organization, Cell cycle: The eukaryotic cell cycle, Regulators of cell cycle progression, events of M phase, cytokinesis, Meiosis, Cell signaling: GPCR and role of second messenger (cAMP), Receptor protein tyrosine kinase, regulation of blood glucose level, calcium as an intracellular messenger, Apoptosis (Programd Cell Death), brief idea of cancer (p53 and pRb).

Unit-2: DNA Replication: Prokaryotic and eukaryotic DNA replication, Mechanisms of DNA replication, enzymes and accessory proteins involved in DNA replication and DNA repair, Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, Modifications in RNA: 5'-Capping, 3'-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

Unit-3: Translation: Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post translational modifications of proteins, Protein Localization: Synthesis of secretory and membrane protein, Import into nucleus, mitochondria, chloroplast and peroxisomes, Regulation of gene expression in prokaryotes and eukaryotes: lac, trp and ara operons, enhancers and silencers.

Unit-4: Mutation: Types, causes and detection, mutant types – lethal, conditional, Base substitution and frame shift mutation, biochemical, loss or gain of function, Germinal verses Somatic mutants, Ames Test. Epigenetics: Introduction, methylation, histone modifications. Allele frequency, Gene Frequency, Hardy Weinberg Equilibrium, Population genetics and its applications, Natural selection and random genetic drift.

Unit-5: Microbial nutrition: requirements, categories, uptake and media. Bacterial growth curve and mathematical model, isolation and maintenance of pure culture, factors affecting growth, measurement of growth, Reproduction in bacteria with emphasis on binary fission and budding; different strategies of reproduction in fungi

Unit-6: Strain Improvement and Microbial Growth Kinetics: Screening for new metabolites - primary and secondary metabolites.
Strain development through selection, mutation, genetic recombination and metabolic engineering methods, Maintenance & preservation of industrially important microorganisms using metabolic active and in-active methods, Stock cultures – primary & working stock cultures, Microbial growth and death kinetics, Batch, Fed-batch, Synchronous and Continuous bioprocess (Chemostat and Turbidostat), yield coefficient, doubling time, specific growth rate, metabolic and biomass productivities.
Unit-7: Bioreactor Design and Control: Introduction to Bioreactor, Design of a typical bioreactor (CSTR, Airlift, Packed bed, Photobioreactor), Different components of Bioreactors (peripherals and accessories such as pH, dissolved oxygen, temperature, foam, gas exchange sensors, biomass probe, aeration and agitation, and cooling components), modifications in design for plant and animal cell cultures, computational

and remote control (SCADA and other data logging and analysis software's), bioprocess automation and application of computers in bioprocessing

Unit-8: Principles and applications of Chromatography. Ion exchange chromatography, Gel filtration chromatography, Hydrophobic interaction chromatography, Affinity chromatography, HPLC, Electrophoresis-Agarose Gel electrophoresis, Polyacrylamide Gel Electrophoresis (Native, SDS PAGE), 2-Dimensional Gel electrophoresis

Unit-9: Recombinant DNA technology: Restriction and modification enzymes; Restriction Digestion- Partial and complete digestion, Linkers and adaptors. Vectors - Plasmids, Cosmids, bacteriophage and other viral vectors, bacterial and yeast artificial chromosomes, The construction of cDNA and Genomic libraries. Genomics and its application, Expressed sequence tags, Human genome project- strategies and implications, Gene therapy: principles, strategies, DNA sequencing methods: Maxam and Gilbert's chemical and Sanger's chain termination methods, and Pyrosequencing; Polymerase chain reaction and its application in research, TA cloning, brief idea of next generation sequencing.

Unit-10: Cells and organs of immune system. Primary, secondary and tertiary lymphoid organs. Types of immunity - Innate and adaptive, Humoral and cell-mediated, Active and passive. Pathogen associated molecular pathway: Toll like receptor, Clonal selection theory. Immunological memory, Antigens and immunogens, B and T cell epitopes; Haptens. Structure and functions of antibodies. Classes of immunoglobulins. CDRs, Valence, affinity and avidity. Antibody variants - Isotypes, Allotypes and Idiotypes.

11. DEPARTMENT OF PHYSICS

Section- B

Mathematical Physics

Dimensional analysis, Vector calculus: linear vector space: basis, orthogonality and completeness; matrices; similarity transformations, diagonalization, eigenvalues and eigenvectors; linear differential equations: second order linear differential equations and solutions involving special functions (Hermite, Bessel, Laguerre and Legendre functions); complex analysis: Cauchy-Riemann conditions, Cauchy's theorem, singularities, residue theorem and applications; Laplace transform, Fourier analysis; elementary ideas about tensors: covariant and contravariant tensors.

Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates, Lagrangian formulation: D'Alembert's principle, Euler-Lagrange equation, Hamilton's principle, calculus of variations; symmetry and conservation laws; central force motion: Kepler problem and

Rutherford scattering; small oscillations: coupled oscillations and normal modes; rigid body dynamics: interia tensor, orthogonal transformations, Euler angles, Torque free motion of a symmetric top; Hamiltonian and Hamilton's equations of motion; Liouville's theorem; canonical transformations: action-angle variables, Poisson brackets, Hamilton-Jacobi equation.

Special theory of relativity: Lorentz transformations, relativistic kinematics, mass-energy equivalence.

Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction, Solutions of electrostatic and magnetostatic problems including boundary value problems; method of images; separation of variables; dielectrics and conductors; magnetic materials; multipole expansion; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; electromagnetic waves in free space, non-conducting and conducting media; reflection and transmission at normal and oblique incidences; polarization of electromagnetic waves; Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge.

Quantum Mechanics

Postulates of quantum mechanics; Wave-particle duality. Schrödinger equation (time-dependent and time-independent), uncertainty principle; Schrodinger equation; Dirac Bra-Ket notation, linear vectors and operators in Hilbert space; one dimensional potentials: step potential, finite rectangular well, tunneling from a potential barrier, particle in a box, harmonic oscillator; two and three dimensional systems: concept of degeneracy; hydrogen atom; angular momentum and spin; addition of angular momenta; variational method and WKB approximation, time independent perturbation theory; elementary scattering theory, Born approximation; symmetries in quantum mechanical systems, Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection.

Thermodynamics and Statistical Physics

Laws of thermodynamics; Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, Micro-canonical, canonical and grand-canonical ensembles and partition functions. macrostates and microstates; phase space; ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, phase equilibria, critical point.

Atomic and Molecular Physics

Spectra of one-and many-electron atoms; spin-orbit interaction: LS and jj couplings; fine and hyperfine structures; Zeeman and Stark effects; electric dipole

transitions and selection rules; rotational and vibrational spectra of diatomic molecules; electronic transitions in diatomic molecules, Franck-Condon principle; Raman effect; EPR, NMR, ESR, X-ray spectra; lasers: Einstein coefficients, population inversion, two and three level systems.

Solid State Physics

Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron and tight binding models; metals, semiconductors and insulators; conductivity, mobility and effective mass; Optical properties of solids; Kramer's-Kronig relation, intra- and inter-band transitions; dielectric properties of solid; dielectric function, polarizability, ferroelectricity; magnetic properties of solids; dia, para, ferro, antiferro and ferri- magnetism, domains and magnetic anisotropy; superconductivity: Type-I and Type II superconductors, Meissner effect, London equation, BCS Theory, flux quantization.

Electronics and Experimental Methods

Semiconductors in equilibrium: electron and hole statistics in intrinsic and extrinsic semiconductors; metal-semiconductor junctions; Ohmic and rectifying contacts; PN diodes, bipolar junction transistors, field effect transistors; negative and positive feedback circuits; oscillators, operational amplifiers, active filters; basics of digital logic circuits, combinational and sequential circuits, flip- flops, timers, counters, registers, A/D and D/A conversion.

Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting,

Nuclear and Particle Physics

Nuclear radii and charge distributions, nuclear binding energy, electric and magnetic moments; semi- empirical mass formula; nuclear models; liquid drop model, nuclear shell model; nuclear force and two nucleon problem; alpha decay, beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclear reactions, conservation laws; fission and fusion; particle accelerators and detectors; elementary particles; photons, baryons, mesons and leptons; quark model; conservation laws, isospin symmetry, charge conjugation, parity and time-reversal invariance.

12. DEPARTMENT OF CHEMISTRY

Section- B

Inorganic Chemistry

Chemical periodicity

Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory)

Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents

Main group elements and their compounds: Allotropy, synthesis, structure and bonding,

industrial importance
Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms
Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications
Organometallic compounds: synthesis, bonding, structure, reactivity
Organometallics in homogeneous catalysis
Cages and metal clusters
Analytical chemistry: separation, spectroscopic, electro- and thermoanalytical methods
Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine
Characterisation by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy, microscopic techniques
Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis
Physical Chemistry
1 Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems; atomic orbitals; orbital and spin angular momenta; tunneling
Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications
Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle
Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems
Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules
Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; magnetic resonance principles
Chemical thermodynamics: Laws, state and path functions; Maxwell’s relations; spontaneity; equilibria; phase transitions and equilibria; phase rule; thermodynamics of gases and solutions
Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and thermodynamic quantities calculations
Electrochemistry: Nernst equation; redox systems; electrochemical cells; Debye-Huckel theory; electrolytic conductance; ionic equilibria; conductometric and potentiometric titrations
Chemical kinetics: Rate laws; temperature dependence; complex reactions; steady state approximation; collision and transition state theories; enzyme kinetics; salt effects; catalysis; photochemical reactions
Colloids and surfaces: Stability and properties; isotherms; surface area; heterogeneous catalysis
Solid state: Crystal structures; Bragg’s law; band structure of solids
Polymer chemistry: Molar masses; kinetics of polymerization

Data analysis: Mean and standard deviation; errors; linear regression; covariance and correlation co efficient

Organic Chemistry

1 IUPAC nomenclature including regio- and stereoisomers

Principles of stereochemistry: configurational and conformational isomerism; stereogenicity; stereoselectivity; enantioselectivity; diastereoselectivity; asymmetric induction

Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions

Organic reactive intermediates: carbocations, carbanions, free radicals, carbenes, benzynes, nitrenes

Organic reaction mechanisms: addition, elimination, substitution; electrophilic, nucleophilic, radical species; reaction pathways

Common named reactions and rearrangements – applications in organic synthesis

Organic transformations and reagents: functional group interconversion, oxidations and reductions, catalysts (organic, inorganic, organometallic, enzymatic)

Chemo-, regio-, and stereoselective transformations

Concepts in organic synthesis: retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung, protecting groups

Asymmetric synthesis: chiral auxiliaries, asymmetric induction (substrate, reagent, catalyst controlled), determination of enantiomeric and diastereomeric excess, enantio-discrimination, optical and kinetic resolution

Pericyclic reactions: electrocyclisation, cycloaddition, sigmatropic rearrangements, concerted reactions

Photochemical reactions in organic chemistry: principles and applications

Synthesis and reactivity of common heterocyclic compounds containing O, N, S

Chemistry of natural products: carbohydrates, proteins, peptides, fatty acids, nucleic acids, terpenes, steroids, alkaloids; biogenesis of terpenoids and alkaloids

Structure determination of organic compounds by IR, UV-Vis, 1H & 13C NMR, Mass spectroscopic techniques

13. DEPARTMENT OF MATHEMATICAL SCIENCES

Section- B

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum.

Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem.

Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence.

Riemann sums and Riemann integral, Improper Integrals.

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral.

Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems.

Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations.

Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem.

Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.

Inner product spaces, orthonormal basis.

Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions.

Analytic functions, Cauchy-Riemann equations.

Contour integral, Cauchy’s theorem, Cauchy’s integral formula, Liouville’s theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem.

Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements.

Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder

Theorem, Euler's Ø- function, primitive roots.

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems.

Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain.
Polynomial rings and irreducibility criteria.
Fields, finite fields, field extensions, Galois Theory.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs):

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs.

Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis:

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical
differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and
Runge-Kutta methods.

Calculus of Variations:

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations:

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent

kernel.

Classical Mechanics:
Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4
Descriptive statistics, exploratory data analysis
Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case).
Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes.
Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range.

Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests.

Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference.
Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression.
Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.
Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.
Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction.
Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1

with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.
All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

14. DEPARTMENT OF COMPUTER APPLICATIONS

Section- B

Engineering Mathematics
Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.
Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
Calculus: Limits, continuity and differentiability. Maxima and Minima. Mean value theorem. Integration.
Probability and Statistics: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.
Computer Science and Information Technology
Digital Logic
Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).
Computer Organization and Architecture
Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).
Programming and Data Structures
Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
Algorithms
Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths

Theory of Computation
Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undecidability.
Compiler Design
Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimization, Data flow analyses: constant

propagation, liveness analysis, common sub expression elimination.

Operating System

System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.

Databases

ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Computer Networks

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

Annexure – II

Rules for Ph. D. in Part-Time Mode

1. The applicant if employed in an educational institute/organization/Industry and must produce a 'No Objection Certificate (NOC)' from his/her employer on or before the interview, clearly stating that:
    I. The candidate is permitted to pursue studies on a part-time basis.
    II. His/her official duties permit him/her to devote sufficient time for research.
    III. If required, he/she will be relieved from the duty to complete the course work.
2. The candidate proves to the satisfaction of the DRC that his/her official duties permit him/her to devote sufficient time for research.
3. The candidate proves to the satisfaction of the DRC that facilities for pursuing research are available at his/her place of work in the chosen field of research.
4. He/she will be required to visit the University (on working days) to meet his/her supervisor in the department at least twice in a month and such visit is to be reported to the Chairperson DRC for the record.

Rules for Ph.D. for Industry-Sponsored Candidates

1. A Ph.D. program may be offered to candidates with a minimum of 05 years of experience in a reputed industry/organization having R&D facilities, Govt. R&D Departments/ National Research Laboratories/ Units of Government/ Quasi Government/ Public sector etc. subject to the availability of Ph.D. seat and fulfilling other criteria for Ph.D. admission.

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD (HARYANA)

A State Government University (Accredited 'A^{+}' Grade by NAAC)

(Established by Haryana State Legislative Act No. 21 of 2009, Recognized by U.G.C. u/s 2 (f) and 12(B) of U.G.C. Act 1956)

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