



COEP Technological University (COEP Tech)

**A Unitary Public University of Government of Maharashtra
Wellesley Road, Shivajinagar, Pune-411005, Maharashtra, India**



INFORMATION BROCHURE & APPLICATION FORM

For

Admission to Doctor of Philosophy (Ph. D.) Program

AY 2024-25

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1. Ph.D. program offered by COEP Tech

The Doctor of Philosophy (Ph.D.) Program is offered by the following Departments in the related areas of specializations.

Program Name	Broad Areas of Research
Civil Engineering	Environmental Engineering, Structural Engineering, Geotechnical & Transportation Engineering, Transportation Engineering, Geotechnical Engineering, Construction Management & Sustainable Construction, Water Resources Construction Management, Construction Engineering, Construction Techniques, Construction Materials, Construction Technology, Contract Management, Geospatial Technology, Building Drawings, Transportation Engineering Environmental Engineering, Solid Waste Hazard Mgmt., Industrial Waste Hazard Mgmt., Environmental Impact Assessment, Advance Hydraulic, Water Resource Management, Air & Noise Pollution, Environmental Sustainability, Irrigation Engg., Water Resource Management, Advanced Hydrology, Ground Water Hydrology, Open Channel Flow, Dam & Hydraulics Structure, Geospatial Technology. Structural Health Monitoring, Composite Materials, Performance Based Design for Tall Structures, Stability & Seismic Analysis of Cold-Formed Steel Structures, Geotechnical Engineering.
Computer Science & Engineering	AI & Image Processing, Machine Intelligence, Neural Networks, AI & Data Science, Cloud, Networking and Security, Cloud Virtualization, VM Management, Digital Forensics on Operating System, Fog (Edge) Computing, Federated Learning, Network Function Virtualization (NVF), Data Mining, Machine Learning, Big Data Analytics, Deep Learning, Database Design, Algorithms, Network and Information Security, Block Chain, Digital Forensics, IDS, Natural Language Processing, Text Mining, Deep Learning, Data Privacy, Cyber & Information Security, Blockchain, Security in web services, Mobile Application Development, Bioinformatics, Data Security, Robotics & AI, Data Mining, Web Application Security, Wireless & Mobile Security, Parallel & Distributed Computing, Deep Learning using GPU Architecture, Multicore Memory System Performance Issues, Cloud & Big Data Analytics, Data Pipeline, Cloud Platform Selection Application Based, Workflow Analysis of Cloud Based Application, Machine Learning for Data Analytics, Data Mining Algorithms for IOT Data Analytics, Optimization of Machine Learning Algorithms, Computer Network.
Electrical Engineering	Power and Energy Systems: Robust and Efficient System Planning, operation and Control, Renewable Energy Integration, Optimal Operation and Control of Power Systems, Power System Protection, Smart Grid, Operation and Control of Micro Grid etc. Power Electronics and Machine Drives: Converters for Renewable Energy and Electric Vehicles, E-mobility, Industrial Drives, Design and Development of Power Electronic Converters etc. Control Systems: Non-linear Systems and Control, Intelligent Control, Optimal Control, Industrial Control and Automation etc.
Electronics & Telecommunication Engineering	Optics & Sensing, Sensor Designing & Development, Biosensors, Bio-MEMS, VLSI Fabrication, Nanotechnology, Nanomaterials, Lab-On-Chip, Micro fluidics, Wireless Communication, Antenna & RF Technologies, Plasmonics, Experimental Physics, Digital Image Processing, Content-Based Image Processing, Deep Learning, AI & ML, IoT, Computer Vision, Signal Processing, Bio-Medical Applications.

Instrumentation & Control	Sliding Mode Control, Vehicle Technology, Image Processing, Process Control, Chemical & Gas Sensors, Smart Sensors, Analytical Instruments, Robotics & Control, Process Control, Medical Robotics, Robust Control, Power Electronics, Power Convertors & its Control, Battery Management System, Biomedical Instrumentation, Signal Processing & Extraction, Renewable Energy Control, Precision Automation, Soft Computing.
Manufacturing Engineering & Industrial Management	Micro Manufacturing, Condition Monitoring, Reliability Engineering, Electrical Discharge Machining, Friction Stir Welding, Manufacturing, CAD/CAM, Reverse Engineering, Additive Manufacturing, ERP, Computer Aided Inspection, Biomedical Device Development, Design for Manufacturing, Smart Manufacturing, Manufacturing Science & Engineering, Condition Monitoring, Manufacturing, Robotics, Manufacturing Engineering, Metrology & Quality Control, Application of AI in Manufacturing, Micromanufacturing, Electrochemical Micromachining, Micro Matching of Advanced Materials, New Product Development, Design for Manufacturing, Biomedical Device Development, Smart Manufacturing, Industry 4.0, Technologies in Manufacturing, DT, IOT, AM, CPS, MAAS/EAAS Mechatronics, Robotics & Manufacturing Automation, Supply Chain & Logistic Management, Production & Operations Management, ERP, Production & Industrial Engineering, Manufacturing Science & Engineering, Micromachining, Maintenance Engineering & Tribology, Non-Conventional Manufacturing, Product Design & Prototype.
Mechanical Engineering	MEMS, Dynamics, Vibration, Condition Monitoring, CFD, IC Engines, Alternative Fuels, Compliant Mechanism, Micro Manufacturing, AI-ML, Industrial Engineering, CAD/CAM/CAE, FEA, Biomaterials, Micro Machining, Laser Machining, Acoustics, Laser Welding, Design Engineering, Tribology, Reliability Engineering, Maintenance Manufacturing Management, Forming Processes, Rapid Prototyping, Composite Materials, Fracture Mechanics, Functional Graded Materials, Auxetic Materials, Heterogeneous Material Modelling, Human Body Segment Modelling, Integrated Thermal Management technology for BEV vehicle, Laser Material Processing, Biomechanics, AI/ML in enhancing product performance & capability, IoT in product development, Third party calibration of Industrial Robot, Redefining the sustainability in Agriculture using Robotization.
Metallurgy & Materials Engineering	Development Of Anode Materials For Solid Oxide Fuel Cell, Valorization Of Slag/Ash, Agricultural Waste Utilization & Biochar Development, Development Of Water Filter To Improve Boiler Efficiency, Sensor Materials For Precision Agriculture, Polymeric Materials, Plastic Waste Management, Nanomaterials & Their Synthesis, Nano Composites, Advanced Composites, Composites For Electronic, Tribological, Biomedical, Aerospace & Automobile Application Etc., Alloy Synthesis, Cryogenic Treatment, Tribology Of Materials, Energy Materials, E-Waste Management, Powder Metallurgy, Powder Metallurgy, 3 D Printing, Thermo-Mechanical Treatment, Corrosion & Surface Protection, Material Design & Property Optimization.
Planning	Urban & Regional Planning, Architecture, Town & Country Planning

2. Important dates:

<i>Process Information</i>	<i>Dates</i>
<i>Commencement of online application form submission.....</i>	<i>19th June 2024 (10 am)</i>
<i>Closure of online application form submission.....</i>	<i>8th August 2024 (5 pm)</i>
<i>Grievance period.....</i>	<i>9th & 10th August 2024</i>
<i>Display of provisionally eligible candidates for RPET on the website.....</i>	<i>10th August 2024 (5 pm)</i>
<i>COEP Tech's Online RPET – (MCQ type) shall be conducted in campus...</i>	<i>13th August 2024</i>
<i>Display of shortlisted candidates for interview.....</i>	<i>13th August 2024</i>
<i>Interview dates of shortlisted candidates.....</i>	<i>14th August 2024 (10 am)</i>
<i>Display of list of selected candidates for admission.....</i>	<i>16th August 2024</i>
<i>Confirmation of admission at COEP Tech.....</i>	<i>20th August 2024</i>

3. Application Processing Fee:

General Category:	Rs. 1000/-
Reserved Category: SC, ST, VJ/DT- NT(A), NT(B), NT(C), NT(D), OBC, SBC, EBC, EWS & Differently abled person	Rs. 500/-

Application processing fee shall be paid online as per procedure given in Annexure –VIII

4. Submission of the application:

Candidates must submit their application form with necessary application fees (along with all the relevant certificates/documents) online through link available on - <http://www.coep.org.in> (applications without online submission of application as well as certificates/documents will not be considered). Candidate should make sure that proper Institute/ Discipline codes are entered & all relevant details are duly filled in the respective fields. Access to the link for *online submission of application opens* on **17.06.2024**. *Last date for the online submission of application* is **16.07.2024** at **5.00 pm**.

5. Online link to fill Ph.D. application form: <https://phdadmission.coep.org.in/>

6. Eligibility for Admission

Educational Qualification:

Eligibility criteria for securing admission are as per University Grant Commission (UGC) (Minimum Standards & Procedures for Award of Ph.D. Degree No. CG-DL-E-07112022-240086) & COEP Technological University (COEP Tech), PhD Program Rules & Regulations w.e.f. 1st of January 2024.

Candidates should carefully read the eligibility criteria available at COEP Technological University before applying on the website - <https://www.coep.org.in/admissions/phdadmissions>

All the applications will be scrutinized/shortlisted based on data submitted by the candidate in the online application form. If, at any stage, it is found that candidates have furnished false or wrong data/ information, their candidature/admission will be rejected/cancelled.

Candidate who has completed:

- A 1st year / 2nd semester Master's degree Program after a 4th years / 8th semester Bachelor's degree Program or a 2nd year / 4th semester Master's degree Program after a 3rd year Bachelor's degree Program or qualification 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 & 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 & standards of the educational institution.
- 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) & other categories of candidates as per the decision of the Commission from time to time.
- Provided that a candidate seeking admission after a 4th year / 8th 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) & other categories of candidates as per the decision of the Commission from time to time.

***Note:** Institute reserves the rights to admit candidates based on merit & performance during written test & Interview. Mere satisfaction of minimum qualification does not entitle admission to Ph.D. programs.*

7. Procedure for Admission to Ph.D. programs

- a. The admission shall be based on the criteria notified by the institution, keeping in view the guidelines/norms in this regard issued by the UGC & other statutory/regulatory bodies concerned, & taking into account the reservation policy of the State Government/institute guidelines from time to time. If, at any stage, it is found that candidates have furnished false or wrong data/ information; their candidature/admission will be rejected/cancelled.
- b. Admission to the Ph.D. program shall be made using the following methods:
 - i. Aspiring candidates must read the "COEP Technological University (COEP Tech) PhD program Rules & regulations" by visiting the link mentioned below -
<https://www.coep.org.in/admissions/phdadmissions>
The selection will be based on COEP TECH's Research Eligibility Test- RPET in campus online mode followed by personal interview. Applicants desirous of exemption from COEP TECH's Research Eligibility Test- RPET in campus online mode are also required to submit an online application form.
 - ii. Institute may admit students through an Entrance Test conducted at the level of the individual. The Entrance test syllabus shall consist of 30% weightage on Research Methodology & 70% weightage shall be subject-specific (Core domain).

- iii. Students who have secured aggregate of 50% marks in the entrance test shall be eligible to be called for the interview.
- iv. A relaxation of 5% marks will be allowed in the entrance examination for the candidates belonging to SC/ST/OBC/differently abled category, Economically Weaker Section (EWS), & other categories of candidate as per the decision of the Commission from time to time.
- v. Institute may decide the number of eligible students to be called for an interview based on the number of Ph.D. seats available.
- vi. The candidates securing a minimum of 50 % marks in the RPET exams or a GATE qualified candidate shall be eligible to be called for the interview. The interview will solely be the criteria for selection of candidate for PhD admission. During the interview, candidates will be interviewed by a panel of experts & PhD guides.
- vii. While filling the application form keep the soft copy of the following documents ready.
 - a. Proof of identity (Copy of Aadhar card/ Passport/ Driving License)
 - b. Proof of qualification (UG & PG marksheet, as applicable)
 - c. Cast Certificate & Certificate of Validity, if applicable
 - d. Non-Creamy Layer Certificate as mandated for the particular category
 - e. Valid GATE scorecard in case of exemption from RPET
 - f. Sponsorship Certificate in case of sponsored candidates
 - g. Proof of experience
 - h. No Objection Certificate from the employer
 - i. Migration Certificate
 - j. Any other Document supporting exemption for RPET

8. Seat Matrix: -

The number of seats depends upon the number of available research guides in the Institute, vacancies available with the guide & research infrastructure in the concerned department. The admission of candidates to Ph.D. program depends on the expertise available in a department & the willingness of the candidate to work in the corresponding research area.

The following table shows the tentative number of seats available in various departments for admission during July-December 2024 session, however, the number of seats may increase/decrease as per the vacancies available at the time of admission & it is also not mandatory to the Institute to fill all vacant positions displayed in AY 2024-25 only.

Sr. No.	Department	Number of Vacant seats
1	Civil Engineering and Planning	21
2	Computer Engineering	33
3	Electrical Engineering	12
4	Electronics & Telecommunication Engineering	10
5	Instrumentation & Control	25
6	Mechanical Engineering	33
7	Metallurgy & Materials Engineering	12
8	Manufacturing Engineering & Industrial Management	26
Total Number of Vacant seats -		172

Reservation policy in the admission will be implemented as per the norms of State Government of Maharashtra. Category wise vacant positions will be displayed by the respective department on the day of Interview.

9. Exemption from the Written Test

The following candidates shall be exempted from Written Test:

- Candidates qualified having valid scores in GATE & any other JRF holder of the apexbodies like CSIR/ UGC/ ICAR/ ICMR/ DBT/ DST/ ICSSR.
- Ph.D. degree holder of any recognized University who desires to pursue Ph.D. at COEP Tech

10. For the types of Ph. D. candidates, Course Duration of the program:

Candidates must read “COEP Technological University (COEP Tech) PhD program Rules & Regulations” at <https://www.coep.org.in/admissions/phdadmissions> and for Fee structure refer web site.

Teaching Assistantship (TA)/Research Assistantship (RA)/ Scholarships in COEP Tech University

	Title of the Project	Research Area	Department	No. research scholars to be funded	Sponsoring Authority	Max. Permissible stipend per month	Name of Principle Investigator	Duration in years
1	Actionable Image insights with deep learning	Data Analysis	Computer	1	Pattern Technologies, India	Rs. 50,000/-	Dr. (Mrs) V. Z. Aattar	3
2	Feasibility Analysis of Turret Gun Mechanism	Robotics and Control	Mechanical	1	DRDO	Rs 37,000/-	Dr. S. S. Ohol	3
3	Centre of Excellance in Industrial product design	Industrial Product Design	Mfg. Engg. and Industrial Mgmt.	2	Govt of Maharashtra	Rs. 30,000/-	Dr. S. S. Anasane	3
4	Integrated system of steel powder synthesis using plasma assisted atomization method for indigenously developed metal 3D printer using selective laser sintering (SLS) technique	Additive Manufacturing	Mfg. Engg. and Industrial Mgmt.	1*	DST	Rs. 25,000/- (JRF)	Dr. (Mrs) A. V. Mulay	2 * (JRF)
5	High Performance Implementation of Predictive Controller for Directed Energy System	Control System, FPGA, Embedded Systems	Instrumentation and Control	1	DRDO	Rs. 42,000/-	Dr. D.N. Sonawane	3
6	Yet to be Finalized	Energy System	Department of Mechanical and Department of Metallurgy	2	Vertiv	Rs. 35,000/-	HoD Mechanical and Metallurgy	Waiting for Approval
7	Shall be finalized at department level	Refer Sr. No. 1 of Information Brochure	Across all circuit Departments	3	Finolex Group	Rs. 30,000/-	All Department Heads	3
8	Yet to be t Finalized	Automated Driving system	Dept. of E& TC, Instrumentation, and Electrical Engineering	2	Faurecia India Pvt. Ltd.	Rs. 35,000/-	Hod of E& TC, Instrumentation, and Electrical Engineering	Waiting for Approval
9	Shall be finalized at department level	Refer Sr. No. 1 of Information Brochure	Across all Departments	8	COEP Tech, University	Rs. 35,000/-	All Department Heads	3

*Note:

1. The TA ships will be provided only on the availability of funds from the funding agency.
2. The stipend may vary depending on the directions issued by the funding agency from time to time or availability of funds.
3. The research scholars will be eligible for the above funding based on his/her performance and subject to recommendations by the committee for providing such funding.
4. Eligible students may also get funding/scholarship through different funding agencies like BARTI/SARTHI/MAHAJYOTI/TRTI etc.

General Instructions:

For detailed information on rules & regulations, syllabus, criteria for exemption in RPET & schedules, Click the URL mentioned below –

<https://www.coep.org.in/admissions/phdadmissions>

In case of queries related to seats available as per the category in respective departments, the candidate can contact the respective departmental PhD coordinators as mentioned in given URL –

<https://www.coep.org.in/admissions/phdadmissions>

- In case of any grievance or dispute, the decision of the Vice Chancellor, COEP Technological University, Pune is final & binding.
- It is the responsibility of the applicant to fulfill eligibility conditions & fulfill admission compliance.
- Candidates who are in the final year of the qualifying examination of the course are allowed to apply for the RPET. However, the admission of such candidates is subject to their passing the qualifying examination.
- In case of any grievance or disputes, the decision of the COEP Technological University shall be final & binding on all.
- Admission to any program does not guarantee a hostel facility.
- For the current year admissions financial support, like a scholarship, fellowship, etc. COEP Technological University has an independent procedure for offering such benefits.
- It is the responsibility of the applicant to fulfill eligibility conditions & comply with the admission requirements. If, at any stage, it is noticed that the candidate or important material facts have made a false claim have been concealed and / or the candidate is not eligible, his candidature shall be liable for cancellation at any stage.
- *Incomplete applications or applications without uploading documents or applications without required fee & fee receipt or applications submitted after the due date*, will be rejected without assigning any reason. The COEP Technological University will not entertain any correspondence in this regard.
- Before filling out the application, please check the vacancy positions for admission displayed on the website.

For any general query, contact: phdadmission@coeptech.ac.in

Appendix –I

List of Documents to be attached along with application form

Attested photocopies of following documents/certificates should be attached with the application form at the time of submission. If a candidate fails to submit applicable documents/certificates along with application form, he/she will not be shortlisted for Ph. D. admission 2024-25.

Sr. No.	Type of Candidate	Copies of documents to be produced along with Application Form for Admission
1.	All Candidates	<ol style="list-style-type: none"> 1. Graduation degree certificate 2. Final year marks list / grade sheet 3. Post graduate degree certificate 4. Post graduate Final year marks list / grade sheet 5. Receipt of application processing Fee 6. Statement of purpose from the candidate (one page justifying the research area)
2.	Nationality Certificate	<p>In lieu of this “<i>Certificate of Indian Nationality</i>” following Certificates/Documents will also be acceptable-</p> <ol style="list-style-type: none"> 1. Indian Passport in the name of the Candidate, issued by appropriate authorities. 2. The School Leaving Certificate indicating the Nationality of the Candidate as ‘Indian’. 3. Birth Certificate of the Candidate indicating the Place of birth of the Candidate is within India.
3.	Backward class Candidates belonging to S.C. / S.T.	<ol style="list-style-type: none"> 1. Caste/Tribe certificate 2. Caste/Tribe validity certificate
4.	Backward class Candidates belonging to VJ/DT-NT(A)/ NT(B) / NT(C) / NT(D) /O.B.C/ SBC	<ol style="list-style-type: none"> 1. Caste certificate 2. Caste validity certificate 3. Non creamy layer certificate @ valid up to 31st March 2025.
5.	Differently abled Certificate (if applicable):	<p>The candidate claiming to be physically handicapped shall produce a certificate from the Director, All India Institute of Physically Handicapped, Mumbai or Dean/Civil Surgeon of the Government / CIVIL HOSPITALS normally located at the District Headquarters, regarding his or her physical disability, & ability to undergo all parts of syllabus for the normal course. Candidates suffering from Dyslexia, Dysgraphia & Dyscalculia are required to produce certificate issued by the ‘Learning Disability Clinic, Lokmanya Tilak Municipal General Hospital, Sion, Mumbai- 22.</p>
6.	Economically Weaker Section (EWS) Candidate	<p>In addition to the documents mentioned in Sr. No. 1 above, Eligibility Certificate for Economically Weaker Section (Appendix-VI) valid for 2024-25</p> <p>सामान्य प्रशासन विभाग शासन वनर्य क्रमांक राआधो/४०१९ प्र. क्र.</p> <p>३१/१६ अ, विनाक ३१.०५.२०२१ आवक दृष्ट्या िर्ल घटकासाठी विविध के लेल्या आरक्षका लाभ घेण्यासाठी पात्रतेसाठीचे प्रमाण</p> <p>(GR Code २०२१०५३११२५०५९९४०७)</p>
7.	Study Leave	Employers letter in case of candidate joining on study leave (Appendix-II)
8.	Full Time Sponsored Candidate	Sponsorship letter for full time candidates (Appendix-III)
9.	Self-Financed Candidate	No objection certificate for self-financed candidates (Appendix-IV)

10.	Part time sponsored Candidate	No objection certificate for Part time sponsored Candidate (Appendix-V)
11.	Foreign Candidate	Please refer the Guidelines, Rules and Regulations Governing Ph.D. programs w.e.f. 1 st January 2024.
12.	Other documents as applicable	Proof of Exemption for Written test
		Statement of purpose from the candidate (one page justifying the research area)
		Copy of first page of research papers published in journal / conferences

Appendix –II

Employer's Letter in case of Candidate joining on Study Leave

(This should be typed on a letterhead of the Institute)

To

The Vice Chancellor,

COEP Technological University,

Pune – 411 005.

Sub: Relieving an employee on Study Leave

Dear Sir/Madam,

We hereby relieve Mr./Mrs./Ms.an employee of this institute on full/half/no pay leave for joining Ph.D. Program (full-time) at COEP Technological University, Pune for a period of years(atleastthreeyears).

Signature of Head of the Institute & Seal of the Institute

Appendix –III

Sponsorship Letter for Full-Time candidates

(This should be typed on letterhead of the sponsoring organization)

To

The Vice Chancellor,

COEP Technological University,

Pune – 411 005.

Sub: Sponsoring of an Employee for Ph.D. Program

Dear Sir/Madam,

We hereby sponsor the candidature of Mr./Mrs./Ms.....who is an employee in our organization, for joining Ph.D. Program in at the Department., School of COEP Technological University, Pune – 411005, as a FULL-TIME candidate.

We shall bear the total expenses of his/her studies. We shall fully relieve him/her of his/her duties in the organization during the entire period of the Ph.D. Program to enable him/her to devote Full -Time to the studies.

Signature & seal of the Sponsoring Authority

Appendix –IV

No Objection Certificate for Self-Financed Candidates

Letterhead of Institute

..... (Name of the candidate) is working with
..... (Name of the Institute) as(Designation).

If (Name of candidate) is admitted in
..... (Name of Dept/School) at COEP Technological University, Pune - 411005,
Maharashtra, India & as a part of Ph.D. Program (full-time), she/he will be relieved to complete his/her
Ph.D. course work.

..... (Name of the Institute) has No Objection in
..... (Name of candidate) joining the Ph.D. Program (full-time) at COEP
Technological University, Pune - 411005, Maharashtra, India.

Name & Signature Principal/Director/ Concerned Industry Authority

Date:

Place:

Appendix –V

No Objection Certificate for Part-time Sponsored Candidates

.....(Name of candidate) is working with
..... (Name of Institute) as(Designation).

If (Name of candidate) is admitted in
..... (Name of Dept/School) at COEP Technological University, Pune - 411005,
Maharashtra, India & as a part of Ph.D. Program, he/she will be allowed to complete his/her Ph.D. course
work.

..... (Name of the Institute) has No Objection in
..... (Name of candidate) joining the Ph.D. Program on a part-time basis at
COEP Technological University, Pune - 411005, Maharashtra, India.

Name & Signature Principal/Director/Concerned Industry Authority

Date:

Place:

Appendix-VI

(For candidate claiming seats reserved for Economically Weaker Section Candidates)

सामान्य प्रशासन विभाग, शासन निर्णय क्र.राआधो ४०१९/प्र.क्र.३१/१६-अ, दि. ३१/०५/२०२१ सोबतचे सहपत्र

परिशिष्ट - अ
महाराष्ट्र शासन

प्रमाणपत्र क्र.

फोटो

वर्ष _____ करीता ग्राह्य

आर्थिकदृष्ट्या दुर्बल घटकाच्या पात्रतेसाठी प्रमाणपत्र

सामान्य प्रशासन विभाग, शासन निर्णय क्र. राआधो ४०१९/प्र.क्र.३१/१६ अ, दिनांक ३१/०५/२०२१ अन्वये
(आर्थिकदृष्ट्या दुर्बल घटकासाठी विहित केलेल्या १०% आरक्षणाचा लाभ घेण्यासाठी)

प्रमाणित करण्यात येते की, श्री/श्रीमती/कुमारी _____ श्री/श्रीमती _____
----- यांचा/यांची मुलगा/मुलगी गाव/शहर -----तालुका _____जिल्हा/विभाग _____
-- महाराष्ट्राचे रहिवासी आहेत. तो/ती ----- जातीचे असून जात /पोटजात/ वर्ग चे असून सदर जात
महाराष्ट्र राज्य लोकसेवा (अनुसूचित जाती, अनुसूचित जमाती, निरधिसूचित जमाती (वि.जा.) भटक्या जमाती
(भ.ज.), विशेष मागास प्रवर्ग (वि.मा.प्र) आणि इतर मागास प्रवर्ग (इ.मा.व) यांच्या साठी आरक्षण) अधिनियम, २००१
(सन २००४ चा महाराष्ट्र अधिनियम ८) या मध्ये नमूद केलेल्या प्रवर्गातर्गत होत नाही.

महाराष्ट्र शासन, सामान्य प्रशासन विभागाचा शासन निर्णय क्र. राआधो ४०१९/प्र.क्र.३१/१६ अ, दिनांक
१२ फेब्रुवारी २०१९ अन्वये त्याच्या/तिच्या कुटुंबाचे स्रोतांचे एकत्रित वार्षिक उत्पन्न रु. -----/-
असून, सदर उत्पन्न रु.८,००,०००/- पेक्षा कमी आहे. त्यामुळे असे प्रमाणित करण्यात येत आहे की, तो/ ती यांचा
आर्थिकदृष्ट्या दुर्बल घटकामध्ये समावेश होतो.

ठिकाण:

दिनांक:

(शिक्का)

सक्षम प्राधिकारी /तहसिलदार

स्वाक्षरी :

नाव :

पदनाम :

हे प्रमाणपत्र अर्जकर्त्याने सादर केलेल्या खालील कागदपत्र/पुरावे यांच्या आधारावर निर्गमित करण्यात येत आहे.

१.

२.

३.

(टिप: सामान्य प्रशासन विभाग, शासन निर्णय क्र.राआधो ४०१९/प्र.क्र.३१/१६-अ, दि.१२/०२/२०१९,नुसार आर्थिक दुर्बल
घटकासाठीच्या आरक्षणाचा लाभ घेण्यासाठी पात्रता प्रमाणपत्र देण्यासाठी सक्षम प्राधिकारी म्हणून तहसिलदार यांना
घोषित करण्यात आले आहे.)

Appendix –VII

Undertaking of Non-association with any Organization as on date

Mr. /Ms./(Name of candidate have work experience of years in the domain of•

I (Name of candidate) am submitting application for admission to Ph.D. program (Part-time) in (Name of Dept / School) at COEP Technological University, Pune - 411005, Maharashtra, India.

In view of this application submission, I (Name of candidate) hereby undertake the following.

1. I am NOT associated with any organization here in India or Abroad in as actual or virtual full-time employee.
2. I am aware that either my admission to the Ph.D. program (Part-time) will be cancelled or Ph.D. degree will be invalidated, if my association as mentioned above during the Ph.D. ongoing period gets discovered by any means, at anytime & anywhere.

Name of the candidate & Signature

Date:

Place:

Appendix-VIII

Steps to be followed for making online payment

Step 1

Go to the mentioned link for SBI-Collect:

<https://www.onlinesbi.sbi/sbicollect/icollecthome.htm>

Step 2

Select Category

“Educational Institutions”



Educational Institutions

Step 3

Write **“COEP Technological University”** in the search tab.

Select Payee

Category: Educational Institutions

Search for Educational Institutions



Step 4 a.

After Selecting the institute

name, in *‘Enter Payment’*

details: **Payment Category** as

PhD Application Fee.

Payment Category*:

Name *

The screenshot shows a dropdown menu with 'PhD Application Fee' at the top. Below it is an empty input field. Under the input field, the word 'Fee' is visible. At the bottom of the dropdown, 'PhD Application Fee' is listed as a selectable option.

Step 4 b.

Fill in your details in the tab. In the next tab, Verify Payment details. After verification of your details Complete your payment.

Step 5

After Payment of the fees, select the Print Receipt option and save the pdf file. Use this pdf-file for online submission purpose.

Appendix-IX

For the RPET examination two papers will be conducted, paper I has 30% weightage & paper II has 70% weightage. Paper I will be based on *Research Methodology* & paper II will be based on respective discipline. All questions shall be multiple choices for paper I & paper II & no negative marking system.

Syllabus for paper I & paper II is given below –

Syllabus for Paper I

Ph.D. Entrance Examination

- Duration of paper I: 30 minutes.

- Max Marks: 30

1. Data Analysis: Data Preparation –Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations & Chi square test including testing hypothesis of association, Analysis of Variance (ANOVA)

2. Statistics: Measures of central tendency – Mean, Median & Mode, Measures of dispersion - Mean deviation, Standard deviation, Moments, Skewness & Kurtosis, Correlation & Regression.

3. Probability: Sample space, Classical definition of probability & Axiomatic approach of probability, Addition theorem on probability, Conditional probability, Multiplication theorem on probability & Baye's theorem, Binomial, Poisson & Normal distributions.

4. Differential Equations: Definition & basic concepts such as order, degree of a differential equation, Ordinary differential equation of first order, Linear differential equation of nth order with constant coefficients.

5. Matrices: Definition of a matrix, types of matrices, Algebra of matrices, Inverse of a matrix by Adjoint method & by Elementary transformation, Rank of a matrix, Solution of system of Linear homogeneous & non-homogeneous equations, Eigen values, Eigen vectors.

6. Computer Fundamentals: 'C' Programming Language, System software, Application software, Operating Systems, Basics of Internet, Browsers, Search Engines.

Syllabus for Paper II

Ph.D. Entrance Examination

- Duration of paper II: 90 minutes.

- Max Marks: 70 Marks

CIVIL & STRUCTURAL ENGINEERING

Structural Engineering: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions & its applications; Centre of mass; Bending moment & shear force in statically determinate beams; Simple stress & strain relationships; Simple bending theory, flexural & shear stresses, Uniform torsion, buckling of column, combined & direct bending stresses. Statically determinate & indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables & frames; Slope deflection & moment distribution methods; Working stress & Limit state design concepts; Design of beams, slabs, columns; Prestressed concrete beams. Steel Structures: Design of tension & compression members, beams & beam- columns, column bases; Connections - simple & eccentric, beam-column connections.

Geotechnical Engineering Soil Mechanics: Three-phase system & phase relationships, index properties; Unified & Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress & quicksand condition; Compaction of soils; One- dimensional consolidation, Shear Strength, Mohr's circle, effective & total shear strength parameters, Stress-Strain characteristics of clays & sand; Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration & cone penetration tests; Shallow foundations – Terzaghi's & Meyerhoff's bearing capacity theories, effect of water table; Combined footing & raft foundation; Contact pressure; Settlement analysis in sands & clays; Deep foundations – dynamic & static formulae, Axial load capacity of piles in sands & clays, pile load test, pile group efficiency, negative skin friction.

Water Resources Engineering: Properties of fluids, fluid statics; Continuity, momentum & energy equations & their applications; Potential flow, Laminar & turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer & its growth; Concept of lift & drag. Forces on immersed bodies; Flow measurement in channels & pipes; Dimensional analysis & hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow & water surface profiles. Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation & routing, surface run-off models, ground water hydrology - steady state well hydraulics & aquifers; Application of Darcy's Law. Irrigation: Types of irrigation systems & methods; Crop water requirements - Duty, delta, evapotranspiration; Gravity Dams & Spillways; Lined & unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Environmental Engineering: Basics of water quality standards – Physical, chemical & biological parameters; Water quality index; Unit processes & operations; Water requirement; Water distribution system; Drinking water treatment. Sewerage system design, quantity of domestic wastewater, primary & secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications. air pollution control, air quality standards, Air quality Index & limits; collection & transportation of solid wastes, engineered systems for solid waste management.

Transportation Engineering: Geometric design of highways - cross-sectional elements, sight distances, horizontal & vertical alignments. Highway materials - desirable properties & tests; Desirable properties of bituminous paving mixes; Design factors for flexible & rigid pavements; Design of flexible & rigid pavement using IRC codes, Traffic studies on flow & speed, peak hour factor.

Construction Materials & Management: Construction Materials: Structural Steel – Composition, material properties & behavior; Concrete - Constituents, mix design, short-term & long-term properties. Types of construction projects; Project planning & network analysis - PERT & CPM; Cost estimation.

Geomatics Engineering: Principles of surveying; Errors & their adjustment; Maps - scale, coordinate system; Distance & angle measurement - Levelling & trigonometric levelling; Traversing & triangulation survey; Total station; Horizontal & vertical curves.

COMPUTER ENGINEERING

Engineering Mathematics: Discrete Mathematics: Propositional & first order logic. Sets, relations, functions, partial orders & lattices. Monoids, Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions. Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues & eigenvectors, LU decomposition. Calculus: Limits, continuity & differentiability. Maxima & minima. Mean value theorem. Integration. Probability & Statistics: Random variables. Uniform, normal, exponential, poisson & binomial distributions. Mean, median, mode & standard deviation. Conditional probability & Bayes theorem.

Digital Logic: Boolean algebra. Combinational & sequential circuits. Minimization. Number representations & computer arithmetic (fixed & floating point).

Computer Organization & Architecture: Machine instructions & addressing modes. ALU, data- path & control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory & secondary storage; I/O interface (interrupt & DMA mode).

Programming & 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 & space complexity. Algorithm design techniques: greedy, dynamic programming & divide- and- conquer. Graph traversals, minimum spanning trees, shortest paths.

Theory of Computation: Regular expressions & finite automata. Context-free grammars & push-down automata. Regular & context-free languages, pumping lemma. Turing machines & undecidability.

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

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

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

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

ELECTRICAL ENGINEERING

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

Electrical Machines: Single phase transformer: equivalent circuit, phasor diagram, open circuit & short circuit tests, regulation & efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles; DC machines: separately excited, series & shunt, motoring & generating mode of operation & their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load & blocked-rotor tests, equivalent circuit, starting & speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical & salient pole machines, performance & characteristics, regulation & parallel operation of generators, starting of synchronous motors; Types of losses & efficiency calculations of electric machines

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

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

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

ELECTRONICS & TELECOMMUNICATION ENGINEERING

Networks, Signals & Systems:

Circuit analysis: Node & mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time & frequency domain analysis of linear circuits: RL, RC & RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation.

Continuous-time signals: Fourier series & Fourier transform, sampling theorem & applications. Discrete-time signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals.

LTI systems: definition & properties, causality, stability, impulse response, convolution, poles & zeroes, frequency response, group delay, phase delay.

Electronic Devices: Energy bands in intrinsic & extrinsic semiconductors, equilibrium carrier concentration, direct & indirect band-gap semiconductors. Carrier transport: diffusion current, drift current, mobility & resistivity, generation & recombination of carriers, Poisson, & continuity equations.

Analog Circuits Diode circuits: Clipping, clamping & rectifiers.

BJT & MOSFET amplifiers: biasing, ac coupling, small signal analysis, frequency response. Current mirrors & differential amplifiers.

Op-amp circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers & oscillators.

Digital Circuits:

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

Sequential circuits: latches & flip-flops, counters, shift-registers, finite state machines, propagation delay, setup & hold time, critical path delay. Data converters: sample & hold circuits, ADCs & DACs.

Semiconductor memories: ROM, SRAM, DRAM. Computer organization: Machine instructions & addressing modes, ALU, data-path & control unit, instruction pipelining.

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

Communications:

Random processes: auto correlation & power spectral density, properties of white noise, filtering of random signals through LTI systems. Analog communications: amplitude modulation & demodulation, angle modulation & demodulation, spectra of AM & FM, super heterodyne receivers. Information theory: entropy, mutual information & channel capacity theorem.

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

Electromagnetics

Maxwell's equations: differential & integral forms & their interpretation, boundary conditions, wave equation, Poynting vector.

Plane waves & properties: reflection & refraction, polarization, phase & group velocity, propagation through various media, skin depth.

Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart.

Rectangular & circular waveguides, light propagation in optical fibers, dipole & monopole antennas, linear antenna arrays.

INSTRUMENTATION & CONTROL

Engineering Mathematics

Linear Algebra: Matrix algebra, systems of linear equations, consistency & rank, Eigen values & Eigen vectors.

Calculus: Mean value theorems, theorems of integral calculus, partial derivatives, maxima & minima, multiple integrals, Fourier series, vector identities, line, surface & volume integrals, Stokes, Gauss & Green's theorems.

Differential equations: First order equation (linear & nonlinear), second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's & Euler's equations, initial & boundary value problems, solution of partial differential equations: variable separable method.

Analysis of complex variables: Analytic functions, Cauchy's integral theorem & integral formula, Taylor's & Laurent's series, residue theorem, solution of integrals.

Probability & Statistics: Sampling theorems, conditional probability, mean, median, mode, standard deviation, & variance; random variables: discrete & continuous distributions: normal, Poisson & binomial distributions.

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression, & correlation analysis.

Electrical Circuits & Machines:

Voltage & current sources: independent, dependent, ideal & practical; v-i relationships of resistor, inductor, mutual inductance & capacitor; transient analysis of RLC circuits with dc excitation.

Kirchoff's laws, mesh & nodal analysis, superposition, Thevenin, Norton, maximum power transfer & reciprocity theorems.

Peak-, average- & rms values of ac quantities; apparent-, active- & reactive powers; phasor analysis, impedance & admittance; series & parallel resonance, locus diagrams, realization of basic filters with R, L & C elements. transient analysis of RLC circuits with ac excitation.

One-port & two-port networks, driving point impedance & admittance, open-, & short circuit parameters.

Single phase transformer: equivalent circuit, phasor diagram, open circuit & short circuit tests, regulation & efficiency; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load & blocked rotor tests, equivalent circuit, starting & speed control; Types of losses & efficiency calculations of electric machines.

Signals & Systems: Periodic, aperiodic & impulse signals; Laplace, Fourier & z-transforms; transfer function, frequency response of first & second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT & FFT; basics of IIR & FIR filters.

Control Systems: Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase & gain margins, Routh & Nyquist criteria, root loci, design of lead, lag & lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic & pneumatic system components, synchro pair, servo & stepper motors, servo valves; on-off, P, P-I, P-I-D, cascade, feedforward, & ratio controllers.

Analog Electronics: Characteristics & applications of diode, Zener diode, BJT & MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of operational amplifiers; applications of op amps: difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, precision rectifier, active filters & other circuits. Oscillators, signal generators, voltage-controlled oscillators, & phase locked loop.

Digital Electronics: Combinational logic circuits, minimization of Boolean functions. IC families: TTL & CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flip flops, shift registers, timers & counters; sample-and-hold circuit, multiplexer, analog-to digital (successive approximation, integrating, flash & sigma-delta) & digital-to analog converters (weighted R, R-2R ladder & current steering logic). Characteristics of ADC & DAC

Measurements: SI units, systematic & random errors in measurement, expression of uncertainty - accuracy & precision index, propagation of errors. PMMC, MI & dynamometer type instruments; dc potentiometer; bridges for measurement of R, L & C, Q-meter. Measurement of voltage, current & power in single & three phase circuits; AC & DC current probes; true rms meters, voltage & current scaling, instrument transformers, timer/counter, time, phase & frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding & grounding.

Sensors & Industrial Instrumentation: Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors & associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear & angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine & open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer & semiconductor); liquid level, pH, conductivity & viscosity measurement.

Optical Instrumentation: Amplitude- & frequency modulation & demodulation; Shannon's sampling theorem, pulse code modulation; frequency & time division multiplexing, amplitude-, phase-, frequency-, pulse shift keying for digital modulation; optical sources & detectors: LED, laser, photo-diode, light dependent resistor & their characteristics; interferometer: applications in metrology; basics of fiber optic sensing.

MECHANICAL ENGINEERING

Design Engineering

Engineering Mechanics: Free-body diagrams & equilibrium; trusses & frames; virtual work; kinematics & dynamics of particles & of rigid bodies in plane motion

Mechanics of Materials: Stress & strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress & plane strain; thin cylinders; shear force & bending moment diagrams; bending & shear stresses; deflection of beams; torsion of circular shafts

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

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

Machine Design: Design for static & dynamic loading; failure theories; fatigue strength & the S-N diagram; principles

Fundamentals of Finite Element Analysis

Thermal Engineering

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies, differential equations of continuity & momentum; Bernoulli's equation; dimensional analysis

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

Thermodynamics: Thermodynamic systems & processes; properties of pure substances, behavior of ideal & real gases; zeroth & first laws of thermodynamics, calculation of work & heat in various processes; second law of thermodynamics

Applications: *Power Engineering:* Air & gas compressors, vapor & gas power cycles, *I.C. Engines:* Air-standard Otto, Diesel & dual cycles. *Refrigeration & air-conditioning:* Vapor & gas refrigeration & heat pump cycles

Manufacturing & Industrial Engineering

Manufacturing Processes: Casting: types of casting processes & applications; patterns, molds & cores, casting techniques Metal Forming: hot & cold working – forging, rolling, sheet metal working processes; Joining of materials: Principles of fusion welding processes - MIG, TIG, plasma arc, submerged arc welding processes, brazing & soldering processes;

Machine Tools & Machining: Centre lathe, milling machine, & drilling machine – construction & kinematics; machining processes - turning, drilling, boring, milling, grinding; single point cutting tools, Non-traditional Manufacturing: Principles, non-traditional machining processes – USM, AJM, WJM, AWJM, EDM, LBM, EBM, ECM Computer Integrated Manufacturing: CAD – geometric modeling, CAM – CNC & robotics – configurations, drives & controls ; Metrology & Inspection: Limits, fits, & tolerances, interchangeability, selective assembly; linear, angular, & form measurements

Operations research: Basic linear algebra; linear programming – problem formulation, simplex method, transportation & assignment models; network flow models; basic concepts & methods of nonlinear

optimization; Production control: Forecasting techniques – causal & time series models, moving average, exponential smoothing, aggregate production planning; master production scheduling; MRP & MRP-II; Inventory – functions, costs, classifications, deterministic inventory models.

METALLURGY & MATERIALS ENGINEERING

Metallurgical Thermodynamics Laws of thermodynamics: First law – energy conservation, Second law - entropy; Enthalpy, Gibbs & Helmholtz free energy; Maxwell's relations; Chemical potential; Applications to metallurgical systems, solutions, ideal & regular solutions; Gibbs phase rule, phase equilibria, binary phase diagram & lever rule, free-energy vs. composition diagrams; Equilibrium constant, Activity, Ellingham & phase stability diagrams; Thermodynamics of point defects, surfaces & interfaces, adsorption & segregation phenomena. Electrochemistry: Single electrode potential, Electrochemical cells, Nernst equation, Potential-pH diagrams.

Transport Phenomena & Rate Processes Momentum transfer: Concept of viscosity, shell balances, Bernoulli's equation, mechanical energy balance equation, flow past plane surfaces & through pipes. Heat transfer: Conduction, Fourier's Law, 1-D steady state conduction

Convection: Heat transfer coefficient relations for forced convection. Radiation: Black body radiation, Stefan-Boltzman Law, Kirchhoff's Law. Mass transfer: Diffusion & Fick's laws, Mass transfer coefficients. Dimensional analysis: Buckingham Pi theorem, Significance of dimensionless numbers. Basic laws of chemical kinetics: First order reactions, reaction rate constant, Arrhenius relation, heterogeneous reactions, oxidation kinetics. Electrochemical kinetics: Polarization.

Mineral Processing & Extractive Metallurgy: Comminution techniques, Size classification, Flotation, Gravity, & other methods of mineral beneficiation; Agglomeration: sintering, pelletizing & briquetting. Material & Energy balances in metallurgical processes; Principles & processes for the extraction of non-ferrous metals – aluminum, copper & titanium. Iron & steel making: Material & heat balance in blast furnace; Structure & properties of slags & molten salts – basicity of slags - sulphide & phosphate capacity of slags; Production of metallurgical coke. Other methods of iron making (COREX, MIDRE) Primary steel making: Basic oxygen furnace, process dynamics, oxidation reactions, electric arc furnace. Secondary steel making: Ladle process – deoxidation, argon stirring, desulphurization, inclusion shape control, principles of degassing methods; Basics of stainless-steel manufacturing. Continuous Casting: Fluid flow in the tundish & mold, heat transfer in the mold, segregation, inclusion control.

Physical Metallurgy Chemical Bonding: Ionic, covalent, metallic, & secondary bonding in materials, Crystal structure of solids – metals & alloys, ionic & covalent solids, & polymers.

X-ray Diffraction: Bragg's law, optical metallography, principles of SEM imaging. Crystal Imperfections: Point, line & surface defects; Coherent, semi-coherent & incoherent interfaces. Diffusion in solids: Diffusion equation, steady state & error function solutions; Examples - homogenization & carburization; Kirkendall effect; Uphill diffusion; Atomic models for interstitial & substitutional diffusion; Pipe diffusion & grain boundary diffusion. Phase transformation: Driving force, Homogeneous & heterogeneous nucleation, growth Kinetics Solidification in isomorphous, eutectic & peritectic systems, cast structures & macro-segregation, dendritic solidification & constitutional supercooling, coring, & micro-segregation. Solid state transformations: Precipitation, spinodal decomposition, ordering, massive transformation, discontinuous precipitation, eutectoid transformation, diffusion less transformations; Precipitate coarsening, Gibbs-Thomson effect. Principles of heat treatment of steels, TTT & CCT diagrams; Surface hardening treatments; Recovery, recrystallization, & grain growth; Heat treatment of cast iron & aluminum alloys. Electronic, magnetic & optical properties of materials. Basic forms of corrosion & its prevention.

Mechanical Metallurgy: Strain tensor & stress tensor, Representation by Mohr's circle, elasticity, stiffness & compliance tensor, Yield criteria, Plastic deformation by slip & twinning. Dislocation theory: Edge, screw & mixed dislocations, source & multiplication of dislocations, stress fields around dislocations; Partial dislocations, dislocation interactions & reactions. Strengthening mechanisms: Work/strain hardening, strengthening due to grain boundaries, solid solution, precipitation & dispersion. Fracture behavior, Griffith theory, linear elastic fracture mechanics, fracture toughness, fractography, ductile to brittle transition. Fatigue: Cyclic stress strain behavior - low & high cycle fatigue, crack growth. Mechanisms of high temperature deformation & failure; creep & stress rupture, stress exponent & activation energy.

Manufacturing Processes: Metal casting: Mold design involving feeding, gating & riser, casting practices, casting defects. Hot, warm & cold working of metals: Metal forming – fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing & sheet metal forming, defects in forming. Metal joining: Principles of soldering, brazing & welding, welding metallurgy, defects in welded joints in steels & aluminum alloys. Powder metallurgy: production of powders, compaction & sintering. Non-destructive Testing (NDT): Dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission & magnetic particle inspection methods.

MANUFACTURING ENGINEERING & INDUSTRIAL MANAGEMENT

Engineering Mathematics:

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

Calculus: Functions of single variable, Limit, continuity & differentiability, Mean value theorems, Evaluation of definite & improper integrals, Partial derivatives, Total derivative, Maxima & minima, Gradient, Divergence & Curl, Vector identities, Directional derivatives, Line, Surface & Volume integrals, Stokes, Gauss & Green's theorems.

Differential equations: First order equations (linear & nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's & Euler's equations, Initial & boundary value problems, Laplace transforms, Solutions of one-dimensional heat & wave equations & Laplace equation.

Complex variables: Analytic functions, Cauchy's integral theorem, Taylor series.

Probability and Statistics: Definition of Probability and Sampling Theorems, Conditional Probability, Mean, median, mode & standard deviation, Random variables, Poisson, Normal & Binomial distributions.

Numerical Methods: Numerical solutions of linear & non-linear algebraic equations Integration by trapezoidal & Simpson's rule, single & multi-step methods for differential equations.

General Engineering:

Engineering Materials: Structure & properties correlation; engineering materials (metals, ceramics, polymers & composites) – properties & applications; stress - strain behavior of metals and alloys; iron-carbon phase diagram, heat treatment of metals & alloys, its influence on mechanical properties.

Applied Mechanics: Engineering mechanics – equivalent force systems, free body concepts, equations of equilibrium; trusses; strength of materials – stress, strain & their relationship; failure theories, Mohr's circle(stress), deflection of beams, bending & shear stress, Euler's theory of columns.

Theory of Machines & Design: Analysis of planar mechanisms, cams & followers; governors & fly wheels; design of bolted, riveted & welded joints; interference/shrink fit joints; design of shafts, keys, spur gears, belt drives, brakes & clutches; pressure vessels.

Thermal & Fluids Engineering: Fluid mechanics – fluid statics, Bernoulli's equation, flow through pipes, equations of continuity & momentum, capillary action, contact angle & wetting; thermodynamics – zeroth, first & second law of thermodynamics, thermodynamic system & processes, calculation of work & heat for systems & control volumes; air standard cycles; heat transfer – basic applications of conduction, convection & radiation.

Manufacturing Processes I:

Casting: Types of casting processes & applications; patterns – types & materials; allowances; moulds & cores – materials, making, & testing; casting techniques of cast iron, steels & nonferrous metals & alloys; analysis of solidification & microstructure development; design of gating & riser; origin of defects.

Metal Forming: Stress-strain relations in elastic & plastic deformation; concept of flow stress; hot & cold working – forging, rolling, extrusion & wire drawing; sheet metal working processes – blanking, bending & deep drawing; ideal work & slab analysis; origin of metal working defects.

Joining of materials: Principles of fusion welding processes (manual metal arc, MIG, TIG, plasma arc, submerged arc welding processes) –different heat sources (flame, arc, resistive, laser, electron beam), & heat transfer & associated losses, flux application, feeding of filler rod; Principles of solid state welding

processes (friction, explosive welding, ultrasonic welding processes); Principles of adhesive, brazing & soldering processes; Origins of welding defects.

Powder processing: Production of metal/ceramic powders, compaction & sintering of metals & ceramic powders.

Polymers & Composites: Plastic processing – injection, compression & blow molding, extrusion, calendaring & thermoforming; molding of composites.

Manufacturing Processes II:

Machine Tools & Machining: Basic machine tools like center lathe, milling machine, & drilling machine – construction & kinematics; machining processes - turning, taper turning, thread cutting, drilling, boring, milling, gear cutting, thread production, grinding; geometry of single point cutting tools, chip formation, cutting forces, specific cutting energy & power requirements, Merchant's analysis; basis of selection of machining parameters; tool materials, tool wear & tool life, economics of machining, thermal aspect of machining, cutting fluids, machinability; Jigs & fixtures – principles, applications, & design

Non-traditional Manufacturing: Principles, applications, effect of process parameters on MRR & product quality of non-traditional machining processes – USM, AJM, WJM, AWJM, EDM & Wire cut EDM, LBM, EBM, PAM, CHM, ECM.

Computer Integrated Manufacturing: Basic concepts of CAD – geometric modeling, CAM – CNC & robotics – configurations, drives & controls, Group Technology & its applications – CAPP, cellular manufacturing & FMS.

Quality & Reliability:

Metrology & Inspection: Limits, fits, and tolerances, gauge design, interchangeability, selective assembly; linear, angular, & form measurements (straightness, squareness, flatness, roundness, & cylindricity) by mechanical & optical methods; inspection of screw threads & gears; surface finish measurement by contact & non-contact methods; tolerance analysis in manufacturing & assembly.

Quality management: Quality – concept & costs; quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000.

Reliability & Maintenance: Reliability, availability & maintainability; distribution of failure & repair times; determination of MTBF & MTTR, reliability models; determination of system reliability; preventive maintenance & replacement.

Industrial Engineering:

Product Design & Development: Principles of good product design, tolerance design; quality & cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering; comparison of production alternatives.

Work System Design: Taylor's scientific management, Gilbreth's contributions; productivity – concepts & measurements; method study, micro-motion study, principles of motion economy; work measurement – time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, & wage administration.

Facility Design: Facility location factors & evaluation of alternate locations; types of plant layout & their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems.

Operations research & Operations management:

Operation Research: Linear programming – problem formulation, simplex method, duality & sensitivity analysis; transportation & assignment models; network flow models, constrained optimization & Lagrange multipliers; Markovian queuing models; dynamic programming; simulation – manufacturing applications.

Engineering Economy & Costing: Elementary cost accounting & methods of depreciation; break -even analysis, techniques for evaluation of capital investments, financial statements, time- cost trade -off, resource leveling.

Production control: Forecasting techniques – causal & time series models, moving average, exponential smoothing, trend & seasonality; aggregate production planning; master production scheduling; MRP & MRP -II; routing, scheduling & priority dispatching; Push and pull production systems, concept of JIT manufacturing system; Logistics, distribution, & supply chain management; Inventory – functions, costs, classifications, deterministic inventory models, quantity discount; perpetual & periodic inventory control systems. Project management – PERT & CPM.

PLANNING

PART A: COMMON SECTION 1:

Architecture, Planning & Design Architectural Graphics; Visual composition in 2D & 3D; Computer application in Architecture & Planning; Anthropometrics; Organization of space; Circulation- horizontal & vertical; Space Standards; Universal design; Building byelaws; Codes & standards.

Section 2: Construction & Management Project management techniques e.g. PERT, CPM etc.; Estimation & Specification; Professional practice & ethics; Form & Structure; Principles & design of disaster resistant structures; Temporary structures for rehabilitation.

Section 3: Environmental Planning & Design Natural & man-made ecosystem; Ecological principles; Environmental considerations in Planning & design; Environmental pollution types, causes, controls & abatement strategies; Sustainable development, goals & strategies; Climate change & built environment; Climate responsive design.

Section 4: Urban Design, landscape & Conservation Historical & modern examples of urban design; Elements of urban built environment – urban form, spaces, structure, pattern, fabric, texture, grain etc.; Concepts & theories of urban design; Principles, tools & techniques of urban design; Public spaces, character, spatial qualities & Sense of Place; Urban design interventions for sustainable development & transportation; Development controls – FAR, densities & building byelaws.; Urban renewal & conservation; heritage conservation; historical public spaces & gardens; Landscape design; Site planning;

Section 5: Planning process Salient concepts, theories & principles of urban planning; concepts of cities - Eco-City, Smart City; Concepts & theories by trendsetting planners & designers; Ekistics; Urban sociology; Social, Economic & environmental cost benefit analysis; Methods of non-spatial & spatial data analysis; Development guidelines such as URDPFI.

Section 6: Housing, Housing typologies; Concepts, principles & examples of neighborhoods; Residential densities; Affordable Housing; Real estate valuation.

Section 7: Services & Infrastructure Firefighting Systems; Building Safety & Security systems; Building Management Systems; Water treatment; Water supply & distribution system; Water harvesting systems; Principles, Planning & Design of storm water drainage system; Sewage disposal methods; Methods of solid waste management - collection, transportation & disposal; Recycling & Reuse of solid waste; Land-use – transportation - urban form inter-relationships; Design of roads, intersections, grade separators & parking areas; Hierarchy of roads & level of service; Para-transits & other modes of transportation, Pedestrian & slow moving traffic planning.

PART B1: ARCHITECTURE

Section B1.1: History & Contemporary Architecture Principles of Art & Architecture; World History of Architecture: Egyptian, Greco-Roman classical period, Byzantine, Gothic, Renaissance, Baroque-Rococo, etc.; Recent trends in Contemporary Architecture: Art nouveau, Art Deco, Eclecticism, International styles, Post Modernism, Deconstruction in architecture, etc.; Influence of Modern art & Design in Architecture; Indian vernacular & traditional Architecture, Oriental Architecture; Works of renowned national & international architects;

Section B1.2: Building Construction & Structural systems Building construction techniques, methods & details; Building systems & prefabrication of building elements; Principles of Modular Coordination; Construction planning & equipment; Building material characteristics & applications; Principles of strength of materials; Alternative building materials; Foundations; Design of structural elements with different materials; Elastic & Limit State design; Structural systems; Principles of Pre-stressing; High Rise & Long Span structures, gravity & lateral load resisting systems.

Section B1.3: Building Services & Sustainability Solar architecture; Thermal, visual & acoustic comfort in built environments; Natural & Mechanical ventilation in buildings; Air- Conditioning systems; Sustainable

building strategies; Building Performance Simulation & Evaluation; Intelligent Buildings; Water supply; Sewerage & drainage systems; Sanitary fittings & fixtures; Plumbing systems; Principles of internal & external drainage system; Principles of electrification of buildings; Elevators & Escalators - standards & uses.

PART B2: PLANNING

Section B2.1: Regional & Settlement Planning Regional delineation; settlement hierarchy; Types & hierarchy of plans; Various schemes & programs of central government; Transit Oriented Development (TOD), SEZ, SRZ etc.; Public Perception & user behavior; National Housing Policies, Programs & Schemes.; Slums, Squatters, & informal housing; Standards for housing & community facilities; Housing for special areas & needs.

Section B2.2: Planning Techniques & Management Application of G.I.S & Remote Sensing techniques in urban & regional planning; Tools & techniques of Surveys – Physical, Topographical, Land use & Socio-economic Surveys; Urban Economics, Law of demand & supply of land & its use in planning; Graphic presentation of spatial data; Local self-governance, Panchayati raj institutions; Planning Legislation & implementation – Land Acquisition Act, PPP etc.; Decision support system & Land Information System; Urban geography & econometrics; Management of Infrastructure Projects; Demography & equity in planning.

Section B2.3: Infrastructure Planning Process & Principles of Transportation Planning & Traffic Engineering; Road capacity & Travel demand forecasting; Traffic survey methods, Traffic flow Analysis; Traffic analyses & design considerations; Traffic & transport management & control in urban areas; Mass transportation planning; Intelligent Transportation Systems; Urban & Rural Infrastructure System Network

