



**JHARKHAND UNIVERSITY OF TECHNOLOGY**  
Science & Technology Campus, Sirkha Toli, Namkum, Ranchi - 834010  
(Jharkhand)

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Letter No. : JUT-451/2020/791

/Ranchi, Date:- 11-11-2020

**Advertisement For AICTE Doctoral Fellowship (ADF) Scheme**

Applications are invited from Eligible Candidates for Ph.D. Program in Engineering / Technology and Science. For more details regarding the disciplines for Ph.D. Program, Eligibility, Exemption and others please log on to **www. jutranchi.ac.in**.

**How to apply:** Application Form & Information Brochure can be downloaded from **www. jutranchi.ac.in**. Downloaded application form will accepted along with a Demand Draft of Rs 3000/- (General/OBC) and Rs. 1000/- (SC/ST/EWS/PH) as Application Fee.

**Last date for submitting the application form** : 27<sup>th</sup> November, 2020

**Date of Entrance Examination** : 8<sup>th</sup> December, 2020

**Date of Interview** : 11<sup>th</sup> December, 2020

By order of Vice Chancellor

Sd/-

**Nodal Officer (ADF)**

Jharkhand University of Technology  
Ranchi



# **JHARKHAND UNIVERSITY OF TECHNOLOGY**

**Science & Technology Campus, Sirkha Toli, Namkum, Ranchi - 834010 (Jharkhand)**

Letter No. : JUT-451/2020/792

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## **AICTE Doctoral Fellowship (ADF) Scheme**

### **1. Eligibility Criteria**

- Research scholar taking admission in the ADF centers of University i.e. NIFFT, Hatia, Ranchi and B.I.T. Sindri, Dhanbad.
- **Relevant Branches:**
  - a. Computer Science & Engineering
  - b. Electrical and Electronics Engineering
  - c. Electronics and Communication Engineering
  - d. Civil Engineering
  - e. Mechanical Engineering.
- Each of the above relevant branches has one AICTE Doctoral Fellowship allocated.
- Secured minimum 75% marks or equivalent CGPA at both Bachelors and Masters (Note: For SC/ST/PH candidate; Requirement is 70% marks or equivalent CGPA)
- Less than 30 years of age as on the date of admission (Note: For SC/ST/PH candidate; Age relaxation of 5 years)
- Qualification in GATE/NET in last five years.

### **2. Amount of Fellowship**

- Rs. 31,000/- pm for the first two years & Rs. 35,000/- pm for the third year. (For JRF to SRF assessment to be done on the parameters by the university as designed by AICTE)
- HRA at the rate of 8%, 16% and 24% as per Government of India Rules.
- Contingency grant @ Rs. 15,000/- per annum.

### **3. Duration of Fellowship**

3 years extendable for 1 more year in two slots of 6 months.

**Application Fee:** A Demand Draft of Rs. 3000/- (Rs. Three Thousand) only in favour of **Jharkhand University of Technology**, payable at **Ranchi** must be attached with the Application Form. However, SC/ST/EWS/PH candidates will pay Rs. 1000/- (Rs One Thousand) only as Application Fee. The completed hard copy of application form should reach the following address on or before 05:00 P.M., 27<sup>th</sup> November, 2020 by Registered/Speed Post only:

The Nodal Officer, ADF  
Jharkhand University of Technology,  
Science & Technology Campus,  
Sirkha Toli, Namkum,  
Ranchi, Jharkhand - 834010.

Last date for submitting the application form	: 27 <sup>th</sup> November, 2020
Date of Entrance Examination	: 8 <sup>th</sup> December, 2020
Date of Interview	: 11 <sup>th</sup> December, 2020
Helpline No	: 9431912543

**Note:** It is requested to go through the Website of Jharkhand University of Technology, Ranchi (i.e. [www.jutranchi.ac.in](http://www.jutranchi.ac.in)) for any further notice.

By order of the Vice-Chancellor,

**Sd/-**

**Registrar (I/C)**

Jharkhand University of Technology, Ranchi



**झारखण्ड प्रौद्योगिकी विश्वविद्यालय, राँची**  
**JHARKHAND UNIVERSITY OF TECHNOLOGY, RANCHI**

विज्ञान एवं प्रावैद्यिकी परिसर (साइंस एण्ड टेक्नोलॉजी कैम्पस),

सिरखा टोली, नामकुम, राँची – 834010 (झारखण्ड)

अभातशिप डॉक्टरल कार्यक्रम में नामांकन हेतु आवेदन पत्र

Application form for Admission to ADF Ph.D. Program

सत्र 2020–21

**Session 2020-21**

<b>विश्वविद्यालय क्रमांक</b> <b>(कार्यालय द्वारा निर्गत)</b> University Roll No. (to be assigned by Receiving Office)			
अभ्यर्थी द्वारा भरा जाना है, हस्ताक्षर के अतिरिक्त To be filled by the candidate in his/her own handwriting in Capital Letters except signature			
<b>मांग पत्र एवं शाखा</b> Demand Draft Bank & Branch	मांग पत्र संख्या DD Number	राशि Amount	
प्री.पी.एच.डी./गेट/नेट/परीक्षा और वर्ष P.Ph.D/ GATE/ NET Exam and Year		कोटि (✓ चिन्ह डालें) CATEGORY (Put ✓ mark)	
चयन परीक्षा क्रमांक संख्या Selection Exam Roll No		सामान्य General	
चयन परीक्षा स्थान (राष्ट्रीय स्तर) Selection Exam Rank (All India)		अन्य पि0वर्ग0/अत्यंत पि0 वर्ग OBC/ EBC	
चयन परीक्षा प्राप्तांक (अंक) Selection Exam Score (marks)		अनुसूचित जाति SC	
चयन परीक्षा विषय Selection Exam Subject		अनुसूचित जन-जाति ST	
चयन परीक्षा/ डिग्री ओर शाखा Qualifying Exam/ Degree and Branch		विकलांग PH	
राज्य का निवासी: Resident of State:		EWS	

**अंतिम चयनित शाखा/विभाग/शोध**  
**Final allotted Branch/ Department/ Specialization**

1.	अभ्यर्थी का पूरा नाम (दसवीं परीक्षा के आधार पर) Name of candidate in full (as per 10 <sup>th</sup> Certificate)		
	देवनागरी लिपि में अभ्यर्थी का नाम (हिन्दी) Name of Candidate in Devnagri (Hindi)		
2.	पिता का नाम Father's Name		
3.	माता का नाम Mother's Name		
4.	अभिभावक का पूरा नाम (यदि पिता जीवित नहीं हों) Guardian's Name in Full (if father is not alive)		
5.	जन्म तिथि (दिन-महीना-वर्ष) Date of Birth (DD-MM-YYYY)		पुरुष/महिला Male/ Female
6.	माता-पिता का व्यवसाय Occupation of Parents	पिता Father:	
	माता-पिता का कुल आय (विभिन्न स्रोतों से) Parent's Income Per Annum From all Sources	माता Mother:	
	संस्थान जहां माता/पिता/अभिभावक काम करते हों Organization Where Father/ Mother or Guardian is		

PHOTOGRAPH  
Affix recent Passport  
Size Photograph

And  
put your signature in the  
box provided  
below this space in  
Black Gel Pen

	Working (If father is not alive)																					
7.	पत्राचार का पता पिन कोड साथ: Correspondence Address with Pin Code:																					
	दूरभाष संख्या (एस.टी.डी. कोड के साथ)/ मोबाईल नं० Phone No. (With STD Code)/ Mobile No.																					
	ई-मेल पता: Email ID:																					
8.	स्थायी पता पिन कोड साथ: Permanent Address with Pin Code:																					
9.	<b>शैक्षणिक विवरणी:</b> <b>Academic Details:</b> <table border="1"> <thead> <tr> <th>परीक्षा Examination</th><th>शाखा / विशेषार्थ Branch/ Specialization</th><th>संस्था / विश्वविद्यालय Institute/ University</th><th>पास होने का वर्ष Year of Passing</th></tr> </thead> <tbody> <tr> <td>प्रवेशिकोत्तीर्ण / दसवीं Matriculation/ 10<sup>th</sup></td><td></td><td></td><td></td></tr> <tr> <td>इंटरमीडिएट / बारहवीं Intermediate/ 12<sup>th</sup></td><td></td><td></td><td></td></tr> <tr> <td>स्नातक स्तर Bachelor's level</td><td></td><td></td><td></td></tr> <tr> <td>स्नाताकोत्तर स्तर Master's Level</td><td></td><td></td><td></td></tr> </tbody> </table>		परीक्षा Examination	शाखा / विशेषार्थ Branch/ Specialization	संस्था / विश्वविद्यालय Institute/ University	पास होने का वर्ष Year of Passing	प्रवेशिकोत्तीर्ण / दसवीं Matriculation/ 10 <sup>th</sup>				इंटरमीडिएट / बारहवीं Intermediate/ 12 <sup>th</sup>				स्नातक स्तर Bachelor's level				स्नाताकोत्तर स्तर Master's Level			
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10.	एसजीपीए / सीजीपीए / प्रतिशत अंक: SGPA/CGPA/%Marks :	एसजीपीए SGPA	सीजीपीए CGPA	प्रतिशत अंक % Marks	कुल प्रतिशत अंक Overall % Marks																	
	प्रवेशिकोत्तीर्ण / दसवीं Matriculation/10 <sup>th</sup>																					
	इंटरमीडिएट / बारहवीं Intermediate/12 <sup>th</sup>																					
	स्नातक डिग्री: Bachelor's Degree:	द्वितीय सेमेस्टर / प्रथम वर्ष 2nd Sem/1st Yr																				
		चौथा सेमेस्टर / द्वितीय वर्ष 4th Sem/2nd Yr																				
		छठा सेमेस्टर / तृतीय वर्ष 6th Sem/ 3rd Yr																				
		आठवा सेमेस्टर / चौथा वर्ष 8th Sem/ 4th Yr																				
	स्नाकोत्तर डिग्री: Master's Degree:	द्वितीय सेमेस्टर / प्रथम वर्ष 2nd Sem/ 1st Yr																				
		चौथा सेमेस्टर / द्वितीय वर्ष 4th Sem/ 2nd Yr																				
		छठा सेमेस्टर / तृतीय वर्ष 6th Sem/3rd Yr																				
11.	<b>अभ्यर्थी की घोषणा:</b> <b>Declaration of the Candidate:</b> मैं ..... पुत्र / पुत्री का श्री ..... घोषित करता / करती हूँ कि:- I ..... Son/ Daughter of Sri ..... declare that:- (ए) उपरोक्त दी गई सूचनाएं सही हैं अगर ये कोई भी सूचना गलत पाई गई तब मेरा / मेरी (अ) इस कोर्स से नामांकन रद्द माना जाएगा (ब) विश्वविद्यालय से निष्कासन हो जायेगा (स) उचित कानूनी कार्रवाई की जाएगी। a ) Information furnished above are correct and in case any of the information is found false or forged, I shall be liable (i) to lose my candidature for admission to the program (ii) will be expelled from the University (iii) appropriate legal action will be taken against me. (बी) नामांकन के पश्चात, मैं विश्वविद्यालय के सभी नियमों का पालन करूँगा।																					

	<p>b) In the event of my being admitted to this University, I shall abide by all the rules and regulations of the University. (सी) मैं अपनी उत्तीर्ण परीक्षा पास प्रमाण पत्र/या विश्वविद्यालय द्वारा दिया गया तिथि के अंतर्गत मैं उत्तीर्णता परीक्षा प्रमाण पत्र जमा कर दूंगा/दूंगी अन्यथा मेरा नामांकन रद्द माना जाएगा। (जो लागू न हो, उसे कृपया काट दें)</p> <p>c) I have Submitted my Qualifying Examination Passing Certificate with the application form./ OR I will Submit my Qualifying Examination Passing Certificate duly notified by JUT, else my admission shall stand cancelled.</p> <p>(Strike our whichever is not applicable)</p>		
स्थान: Place: दिनांक: Date:	अभ्यर्थी का हस्ताक्षर Signature of the Candidate		
12.	<p>पिता/ अभिभावक का घोषणा: अभ्यर्थी अपने पिता/अभिभावक द्वारा स्वयं लिखित घोषणा पत्र का समर्पित करेंगे यदि नामांकन के समय पिता/अभिभावक अनुपस्थित हों।</p> <p><b>Declaration of the Father/ Guardian:</b> Candidates may Submit the declaration of Father/ Guardian in their handwriting separately even after admission if Father/ Guardians is not available at the time of admission.</p> <p>मैं .....घोषणा करता/करती हूँ कि किसी गतिविधि में श्री/श्रीमति/सुश्री.....का नामांकन इस विश्वविद्यालय में होने जा रहा है, मैं सारे बकाये का भुगतान इसके अध्ययन का सत्र पूरा होने तक जमा कर दूंगा। मैं पुनः प्रमाणित करता हूँ कि इसमें जो भी सूचनाएं दी गई हैं वह सत्य है।</p> <p>I .....(Name) declare that in the event of Sri/Smt./Miss.....being admitted to this University, I shall be responsible for his/ her conduct and undertake to pay all his/ her dues regularly till the completion of his/ her studies. I further certify that the Information furnished by him/ her are correct.</p>		
	स्थान: Place: तारीख Date: अभ्यर्थी का पूरा नाम Name of the Candidate in full	पिता/ अभिभावक का हस्ताक्षर Signature of Father/ Guardian  क्रमांक संख्या (जो कार्यालय द्वारा स्वीकृत किया गया हो) Roll No. (to be assigned by Receiving office)	
1 .	कृपया निम्नलिखित स्वअभिप्रमाणित प्रतिलिपि की जांच (अगर लागू हो) Please verify the Self attested Photocopies of the following:- (as applicable)	Must be submitted at the time of Admission	निशान ✓ लगाएं (Put ✓ mark)
(I)	गेट/नेट रैंक कार्ड/स्कोर कार्ड (अगर लागू हो) GATE/NET Rank Card/ Score Card (if applicable)		
(ii)	अन्य पिछड़ा वर्ग/अनुसूचित जाति/अनुसूचित जन जाति प्रमाण पत्र किसी योग्य व्यक्ति द्वारा निर्गत Certificate of Category OBC/SC/ST, (if applicable), Issued by the competent authority.		
(iii)	अन्य पिछड़ा वर्ग अभ्यर्थी का आय प्रमाण पत्र ताकि क्रीमिलेयर के दावा को स्पष्ट किया जा सके, योग्य व्यक्ति द्वारा निर्गत किया गया हो। मानव विकास मंत्रालय के निर्देशानुसार (अगर अन्य पिछड़ा वर्ग कोटि में सीट उपलब्ध हो।) Income Certificate of Category OBC Candidates for claim with respects to Non Creamy Layer Issued by competent authority as per directive for the MHRD. (if seat allotted in OBC Category)		
(iv)	विकलांग व्यक्ति/शारीरिक अक्षमता का प्रमाण पत्र। Certificate for person with Disabilities Physically Handicapped		
(v)	दसवीं का जन्म तिथि प्रमाण का अंक पत्र। Class X (High School) Board Certificate as proof of Date of Birth		
(vi)	दसवीं का अंक पत्र Matriculation (10 <sup>th</sup> ) Mark Sheet		
(vii)	उत्तीर्णता परीक्षा का अंक पत्र/ ग्रेड कार्ड (जो लागू न हो उसे काट दें) Qualifying Examination Mark Sheet/ Grade Card: (Strike our whichever is not applicable)		
	इंटरमीडिएट का अंक पत्र Intermediate (12 <sup>th</sup> ) Mark Sheet		
	बी.टेक/ बी. ई/बी.एस.सी. अभियंत्रण शिक्षा B.Tech/ B.E./M.Sc. Engg. / M.Sc.		
	एम. टेक./एम ई/एम.एस.सी. अभियंत्रण शिक्षा M. Tech./ M.E./M.Sc. Engg./ M.Sc.		

(viii)	उत्तीर्णता परक्षा प्रमाण पत्र (अगर नहीं जामा किया गया हो तो विश्वविद्यालय द्वारा दिये गये तिथि के अंदर जमा करना) Qualifying Examination passing Certificate (as applicable for the program) In case it is not being submitted then undertaking for submission by due date fixed by Jharkhand University of Technology, Ranchi to be submitted.		
(ix)	फोटोग्राफ की दो प्रतिलिपि जो एक आवेदनपत्र पर चिपकांग गया हो जैसा ही होना चाहिए। Two passport size Photographs. (identical to one Pasted on the application form)		
(x)	प्रवजन प्रमाण पत्र, विश्वविद्यालय से बाहर जाने के उद्देश्य से। Migration Certificate from the University/ Deemed University/Institute/ last Attended		
(xi)	डी0डी0 नामांकन के लिये। Demand Certificate from the University Fee as per Information Brochure/ program		
2 .	सक्षम पदाधिकारी का हस्ताक्षर Signature with full name and designation of Verifying Officer(S):		
	1..... 2 ..... 3 .....		
(एडमिशन के समय केवल संस्थान के मान्य व्यक्ति के लिये) (To be obtained at the time of admission in presence of Institute representative only)			
3 .	अभ्यर्थी का हस्ताक्षर: Signature of the Candidate:		
	अभ्यर्थी का बायें अंगूठे के निशान Left Thumb impression of the Candidate		
	हस्ताक्षर विभाग के विभागाध्यक्ष/सेंटर/संस्थान Signature of Admission-in-Charge of the Department / Centre/ Institute.		



## UNIVERSITY GRANTS COMMISSION

### NET BUREAU

### SYLLABUS

**Subject: GENERAL PAPER ON TEACHING & RESEARCH APTITUDE**

**Code No. : 00**

### PAPER-I

The main objective is to assess the teaching and research capabilities of the candidates. The test aims at assessing the teaching and research aptitude as well. Candidates are expected to possess and exhibit cognitive abilities, which include comprehension, analysis, evaluation, understanding the structure of arguments, deductive and inductive reasoning. The candidates are also expected to have a general awareness about teaching and learning processes in higher education system. Further, they should be aware of interaction between people, environment, natural resources and their impact on the quality of life.

The details of syllabi are as follows:

#### **Unit-I      Teaching Aptitude**

- Teaching: Concept, Objectives, Levels of teaching (Memory, Understanding and Reflective), Characteristics and basic requirements.
- Learner's characteristics: Characteristics of adolescent and adult learners (Academic, Social, Emotional and Cognitive), Individual differences.
- Factors affecting teaching related to: Teacher, Learner, Support material, Instructional facilities, Learning environment and Institution.
- Methods of teaching in Institutions of higher learning: Teacher centred vs. Learner centred methods; Off-line vs. On-line methods (Swayam, Swayamprabha, MOOCs etc.).

- Teaching Support System: Traditional, Modern and ICT based.
- Evaluation Systems: Elements and Types of evaluation, Evaluation in Choice Based Credit System in Higher education, Computer based testing, Innovations in evaluation systems.

## **Unit-II      Research Aptitude**

- Research: Meaning, Types, and Characteristics, Positivism and Post-positivistic approach to research.
- Methods of Research: Experimental, Descriptive, Historical, Qualitative and Quantitative methods.
- Steps of Research.
- Thesis and Article writing: Format and styles of referencing.
- Application of ICT in research.
- Research ethics.

## **Unit-III      Comprehension**

- A passage of text be given. Questions be asked from the passage to be answered.

## **Unit-IV      Communication**

- Communication: Meaning, types and characteristics of communication.
- Effective communication: Verbal and Non-verbal, Inter-Cultural and group communications, Classroom communication.
- Barriers to effective communication.
- Mass-Media and Society.

## **Unit-V      Mathematical Reasoning and Aptitude**

- Types of reasoning.
- Number series, Letter series, Codes and Relationships.
- Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.).



## **Unit-VI      Logical Reasoning**

- Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical square of opposition.
- Evaluating and distinguishing deductive and inductive reasoning.
- Analogies.
- Venn diagram: Simple and multiple use for establishing validity of arguments.
- Indian Logic: Means of knowledge.
- Pramanas: Pratyaksha (Perception), Anumana (Inference), Upamana (Comparison), Shabda (Verbal testimony), Arthapatti (Implication) and Anupalabddhi (Non-apprehension).
- Structure and kinds of Anumana (inference), Vyapti (invariable relation), Hetvabhasas (fallacies of inference).

## **Unit-VII      Data Interpretation**

- Sources, acquisition and classification of Data.
- Quantitative and Qualitative Data.
- Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of Data.
- Data Interpretation.
- Data and Governance.

## **Unit-VIII      Information and Communication Technology (ICT)**

- ICT: General abbreviations and terminology.
- Basics of Internet, Intranet, E-mail, Audio and Video-conferencing.
- Digital initiatives in higher education.
- ICT and Governance.

## **Unit-IX      People, Development and Environment**

- Development and environment: Millennium development and Sustainable development goals.
- Human and environment interaction: Anthropogenic activities and their impacts on environment.
- Environmental issues: Local, Regional and Global; Air pollution, Water pollution, Soil pollution, Noise pollution, Waste (solid, liquid, biomedical, hazardous, electronic), Climate change and its Socio-Economic and Political dimensions.
- Impacts of pollutants on human health.
- Natural and energy resources: Solar, Wind, Soil, Hydro, Geothermal, Biomass, Nuclear and Forests.
- Natural hazards and disasters: Mitigation strategies.
- Environmental Protection Act (1986), National Action Plan on Climate Change, International agreements/efforts -Montreal Protocol, Rio Summit, Convention on Biodiversity, Kyoto Protocol, Paris Agreement, International Solar Alliance.

## **Unit-X      Higher Education System**

- Institutions of higher learning and education in ancient India.
- Evolution of higher learning and research in Post Independence India.
- Oriental, Conventional and Non-conventional learning programmes in India.
- Professional, Technical and Skill Based education.
- Value education and environmental education.
- Policies, Governance, and Administration.

**NOTE:**

- (i) Five questions each carrying 2 marks are to be set from each Module.
- (ii) Whenever graphical/pictorial question(s) are set for sighted candidates, a passage followed by equal number of questions and weightage be set for visually impaired candidates.

## **CS: Computer Science and Information Technology**

### Section 1: Engineering Mathematics

**Discrete Mathematics:** Propositional and first order logic. Sets, relations, functions, partial orders and lattices. 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:** Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

### Section 2 – 10: Computer Science and Information Technology

#### 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. 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 search, 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.

#### Section 8: Operating System

Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU 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. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

## **EE:           Electrical Engineering**

### **Section 1: Engineering Mathematics**

**Linear Algebra:** Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

**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, 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.

**Numerical Methods:** Solutions of nonlinear algebraic equations, Single and Multi-step methods for differential equations.

**Transform Theory:** Fourier Transform, Laplace Transform, z-Transform.

### *Electrical Engineering*

### **Section 2: Electric Circuits**

Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, Three phase circuits, Power and power factor in ac circuits.

### **Section 3: 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.

### **Section 4: Signals and Systems**

Representation of continuous and discrete-time signals, Shifting and scaling operations, Linear Time Invariant and Causal systems, Fourier series representation of continuous periodic signals, Sampling theorem, Applications of Fourier Transform, Laplace Transform and z-Transform.

### **Section 5: Electrical Machines**

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Auto-transformer, Electromechanical energy conversion principles, DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and speed control of dc motors; Three phase induction motors: 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, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

### **Section 6: Power Systems**

Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, 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 and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

#### Section 7: Control Systems

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

#### Section 8: Electrical and Electronic Measurements

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

#### Section 9: Analog and Digital Electronics

Characteristics of diodes, BJT, MOSFET; Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback amplifiers; Operational amplifiers: Characteristics and applications; Simple active filters, VCOs and Timers, Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters, 8085Microprocessor: Architecture, Programming and Interfacing.

#### Section 10: Power Electronics

Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.

## **EC: Electronics and Communication Engineering**

### **Section 1: Engineering Mathematics**

**Linear Algebra:** Vector space, basis, linear dependence and independence, matrix algebra, eigenvalues 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 equations (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 and Stoke's theorems.

**Complex Analysis:** Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.

**Numerical Methods:** Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

**Probability and Statistics:** Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

### **Section 2: Networks, Signals and Systems**

**Network solution methods:** nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.

**Continuous-time signals:** Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

### **Section 3: Electronic Devices**

Energy bands in intrinsic and extrinsic silicon; 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; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

### **Section 4: Analog Circuits**

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op- amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

## Section 5: Digital Circuits

Number systems; 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 and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

## 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: autocorrelation 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, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

## Section 8: Electromagnetics

Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: 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; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

## **CE: Civil Engineering**

### **Section 1: Engineering Mathematics**

**Linear Algebra:** Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.

**Calculus:** Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima, Taylor and Maclaurin series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

**Ordinary Differential Equation (ODE):** First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; Laplace transform and its application in solving linear ODEs; initial and boundary value problems.

**Partial Differential Equation (PDE):** Fourier series; separation of variables; solutions of one-dimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equation.

**Probability and Statistics:** Definitions of probability and sampling theorems; Conditional probability; Discrete Random variables: Poisson and Binomial distributions; Continuous random variables: normal and exponential distributions; Descriptive statistics - Mean, median, mode and standard deviation; Hypothesis testing.

**Numerical Methods:** Accuracy and precision; error analysis. Numerical solutions of linear and non-linear algebraic equations; Least square approximation, Newton's and Lagrange polynomials, numerical differentiation, Integration by trapezoidal and Simpson's rule, single and multi-step methods for first order differential equations.

### **Section 2: 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.

### **Section 3: 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; One- dimensional 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.

#### Section 4: 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.

#### Section 5: 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 and 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.

#### Section 6: 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.

## Section 7: 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).

## **ME: Mechanical Engineering**

### Section 1: Engineering Mathematics

**Linear Algebra:** Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

**Calculus:** Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

**Differential equations:** First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

**Complex variables:** Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

**Probability and Statistics:** Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

### Section 2: Applied Mechanics and Design

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

**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; 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.

### Section 3: Fluid Mechanics and Thermal Sciences

**Fluid Mechanics:** Fluid properties; fluid statics, manometry, buoyancy, 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.

**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. *Turbo machinery:* Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.

#### Section 4: 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, design of jigs and fixtures.

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

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

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

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

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