Admission Brochure for Ph.D. Second Semester 2025-26

BITS Pilani

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BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

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About BITS Pilani

BITS Pilani is a Deemed to be University, offering on-campus programs to more than 18,500 students across its campuses in Pilani, Goa, Hyderabad, Mumbai and Dubai.
It has been recognized as an Institute of Eminence by the Ministry of Education, Government of India in 2020.

In NIRF-2025 Rankings released by the Ministry of Education, Government of India, the institute has ranked the 7th position in the University category and secured 2nd in Pharmacy nationwide.
The institute also advanced to 11th in Engineering, 18th in Research Institutions, and 16th in Overall ranking.

In QS Asia University Rankings 2025, BITS has been ranked 171st in Asia and 15th in India. Further, BITS Pilani has been ranked among the top 300 in QS World University Graduate Employability Rankings 2022 and within top 6 in India.

Having pioneered several curricular and pedagogic attributes, BITS Pilani has a vision to be amongst the top research-led Institutes in the country. The qualities of innovation, enterprise, commitment to excellence, adherence to merit, and transparency, have characterized the Institute during its inexorable march to eminence.

The Institute has secured over Rs 398 crores as external research funding in the last 5 years. State of the art facilities have been developed to support cutting edge research, led by students and about 930 faculty members, leading to a Scopus h-index of 156, with 221 patents filed so far, and 41 patents granted. Currently, there are 14 BITSian Unicorns and 1 Decacorn. There are over 7500 BITSian founders and co-founders of enterprises.

PhD Admissions (Second Semester, 2025–2026)

Applications are invited for Second Semester admission to the PhD program (Full time and/or Part time) starting January 2026 in Pilani, Goa and Hyderabad campuses of BITS Pilani in the following Departments:

- Engineering: Chemical, Civil, Computer Science and Information Systems, Electrical & Electronics, Mechanical
- Science: Biological Sciences, Chemistry, Mathematics, Physics
- Pharmacy
- Economics & Finance, Humanities & Social Sciences, Management

For details about vacancies in specialized area, please visit department website on BITS Pilani official portal or contact the Head of the department/Convener DRC (Department Research Committee) through email.

Department openings with regard to the Full-time and Part-time student admission[#] are tabulated below:

DEPARTMENT	PILANI		GOA		HYDERABAD	
	Full Time	Part Time	Full Time	Part Time	Full Time	Part Time
Biological Sciences	Yes	No	Yes	Yes	Yes	Yes
Chemical Engineering	Yes	Yes	Yes	Yes	Yes	Yes
Chemistry	Yes	Yes	Yes	Yes	Yes	Yes
Civil Engineering	Yes	Yes	NA	NA	Yes	Yes
Computer Science and Information Systems	Yes	Yes	Yes	Yes	Yes	Yes
Economics & Finance	Yes	No	Yes	No	Yes	Yes
Electrical & Electronics Engineering	Yes	Yes	Yes	Yes	Yes	Yes
Humanities & Social Sciences	Yes	Yes	Yes	Yes	Yes	Yes
Management	Yes	Yes	Yes	No	Yes*	Yes**
Mathematics	Yes	Yes	Yes	Yes	Yes	Yes
Mechanical Engineering	Yes	Yes	Yes	Yes	Yes	Yes
Pharmacy	Yes	Yes	NA	NA	Yes	Yes
Physics	Yes	Yes	Yes	No	Yes	Yes

Yes – Department intends to admit students under the specified scheme.
No – Department does not intend to admit students under the specified scheme.
NA - Not Available
* Applications are open only in the area of Strategy & Entrepreneurship; HR & OB; Marketing.
** Applications are open only in the area of Marketing.

Information on specific departments and related research activities is available on the department website of respective campuses. Candidates are requested to visit the relevant website and if needed, further contact the concerned Head of Department (HOD) for details.

Full-time Students: Preferably individuals who would like to pursue Ph.D. in-house, residing on campus.

Part-time Students: Preferably individuals working in organizations providing basic facilities and environment for research.

#This call is for Full-Time & Part-Time students' admission only. If you wish to apply in other scheme please visit BITS Pilani/ AGSRD Website for details or contact the AGSRD Office, BITS Hyderabad Campus.

Minimum eligibility qualifications

- M.E./M.Tech./M.Pharm./MBA/M.Phil. or an equivalent degree with a minimum of 60% aggregate in the qualifying examination
- M.Sc./B.E./B.Pharm. or an equivalent degree with a minimum of 60% aggregate in the qualifying examination
- For admissions to Humanities and Social Sciences, candidates with an M.A. degree and a minimum of 55% aggregate may apply.
- For part-time applicants, a minimum of one year experience in the related field of study is required.
- Meeting the minimum eligibility criteria does not guarantee admission into the PhD program.
- In addition, Departments may set specific admission criteria for shortlisting. **Candidates are advised to visit the departmental website for specific admission criteria.**
- Shortlisted candidates will have to appear for an admission test, which may comprise of a written exam and/or interview as recommended by the DRC (Department Research Committee).
- Candidates admitted with qualifications equivalent to BITS First Degree programmes including M.Sc., B.E., B.Pharm. etc., will be required to do course work with minimum of 6 courses and minimum 24 units in the first and second semester after admission to the programme.
- Candidates admitted with qualifications equivalent to BITS Higher Degree Programmes including M.E./M.Tech./M.Pharm./MBA/M.Phil. etc., will be required to do course work with minimum of 2 courses and minimum of 6 units in the first semester after admission to the programme.
- The admission will be provisional and will be formalized after passing a qualifying exam and/or submissions of PhD Proposal by the Departmental Research Committee (DRC) of the relevant discipline.

Financial assistance

All the full-time Ph.D. students admitted into the Ph.D. program will receive fellowship up to a maximum of five years.

The fellowship could be from the Institute or Sponsored Projects. Ph.D. students may also have their own fellowship if qualified through UGC/CSIR NET.

Students offered Institute fellowship will receive ₹37,000 per month. The fellowship may be enhanced to ₹40,000/- or ₹42,000/- after two years based on the performance. Institute Fellows will also receive a contingency amount of ₹20,000/- per year.

Students offered admission through Sponsored Projects would receive the fellowship in accordance with the funding agency guidelines.

BITS Pilani provides an International Travel Support of up to ₹1.5 lakh to full-time Ph.D. students to present their work in an international conference.

Important Dates

Activity	Date/ deadline
Admissions open for II Semester 2025-2026	**26th September 2025**
Last date for submission of application	**17th November 2025**
Declaration of shortlisted candidates for written test and interview	**28th November 2025**
Written test and/or interview date	**17th and 18th December 2025**
Announcement of admission offers	**24th December 2025**
Last date for fee payment	**3rd January 2026**
Reporting at the respective BITS Pilani campus selected for	**3rd January 2026**
Course registration	**5th January 2026**
Beginning of classwork	**6th January 2026**
Orientation	**7th to 10th January 2026**

The Institute reserves the right to change the above deadlines. Candidates will be informed in advance should there be such a change.

Applicants are advised to take careful note of the dates scheduled for the written test/interview and the reporting date for joining the institute, to make appropriate travel arrangements well in advance.

Application Process

1. The Admission portal to apply online opens on **26th September 2025**.

2. Interested and eligible candidates should apply through the prescribed application form available online at https://bitsadmission.com/bitsphweb/Index.aspx. Hard copy of the application form is not required to be sent. Candidates are advised to take a printout of the filled form and retain it for further reference.

3. Candidates will need to register online prior to filling the application form. A registered mobile number and email ID will be required to generate a username and password essential for filling the application form.

4. While filling the application form online, candidates are required to give preference of the campus or campuses to which they wish to apply for. **It is advised that the candidates provide preference after careful thought. This preference will be used to assign the campus for appearing in the written test/interview if shortlisted. The preferences cannot be changed after submission of application.** Please refer to Department offering full and part-time admissions prior to filling the application form.

5. The completed application form along with the prescribed application fee should be submitted online by the prescribed deadline. Details on modes of Fee Payment will be available while applying online. **Campus preference and priority cannot be changed once the application form is submitted#.**

6. Deadline for submission of the completed application form online is **5:00 PM on 17th November 2025**.

7. A non-refundable application fee of Rs. 2600/- is payable at the time of submission of the online form.

8. A candidate can submit only one application form for PhD admission. However, if a candidate discovers any mistake in the form to be submitted by him/her, there will be an **edit option#** which will be made available before the final submission of the application form, which he/she can make use of to incorporate necessary changes. This option will be available only till the deadline for submission of the form which is **5:00 PM on 17th November 2025.**

9. The final decision on admitting the candidates to the PhD program will be taken by the Admission Committee of the Institute and will be binding on all.

 # It is advised to choose a campus (Pilani/Goa/Hyderabad) nearer to your current location to avoid any travel hassles.

Written Test Details

A. Candidates shortlisted for test in any of the following Departments.

Candidates shortlisted for the department of **Biological Sciences, Chemistry, Mathematics, or Physics** will be required to write a test. The details of the tests are as follows:

The question paper will consist of 50-100 multiple-choice questions, all subject specific, covering the relevant syllabus for the candidate. The total duration of the test will be 2-3 hrs.

Negative Marking may be applicable, with a 25% deduction in marks of each incorrect answer.

Candidates with M.Phil. / M.E. / M.Tech. or with National level fellowships like CSIR NET-JRF, DBT-JRF, UGC NET-JRF etc. are exempted from writing the above test.

B. Candidates shortlisted for Test in any of the following Departments:

Candidates shortlisted for the department of **Humanities & Social Sciences/ Economics & Finance** will have to write two tests. Test-I will be common to both disciplines and Test-II will be discipline specific. The details of the tests are as follows:

- Test-I will comprise of the following components:

S.No.	Component	Number of Questions	Time (in minutes)
1	Reading Comprehension (2 Passages)	5 Questions for each passage (10 questions in total)	20
2	Logical Reasoning	10 questions	10
3	Analytical Reasoning	15 questions	15
4	General Awareness	15 questions	15

- Test-II for candidates shortlisted in Humanities & Social Sciences will be discipline specific and **subjective** in nature.

Candidates with an M.Phil. degree or with fellowships like CSIR NET-JRF, DBT-JRF, UGC NET-JRF etc. are exempted from writing the above test.

C. **All Candidates shortlisted for the Department of Management, Pilani campus, need to appear in a <u>One-hour subjective test.</u>**

The nature of the written test will be application-based in the areas of Business & Management to test basic management knowledge and research aptitude.

Based on the test results, there may be shortlisting of candidates for Interview.

D. **Candidates with a B.E./B.Pharm. or an equivalent degree, if shortlisted, will be required to appear for the written test.**

The test for B.E./B.Pharm. will be conducted by the Departments concerned as per the applicants' discipline and will be informed after shortlisting the applicants.

Based on the test results, there may be shortlisting of candidates for Interview.

All notices/shortlists will be put on the admission website https://bitsadmission.com/bitsphweb/Index.aspx. Candidates are advised to check this website regularly. No written communication will be sent to the candidates.

Syllabus for Test

1. Biological Sciences

Subject	Content	Reference Books
Genetics	Laws of inheritance and genetic interaction, Genetic mapping in Virus. Bacteria, & Eukaryotes, Gene expression in prokaryotes and eukaryotes, Control of gene expression in prokaryotes eukaryotes and Viruses., Population and evolutionary genetics	Principles of Genetics – Robert H. Tamarin, 7th edition, Tata McGraw–Hill, 2002.
Molecular Technique	Restriction endonucleases, Vectors and cloning, Blotting technique, PCR, Sequencing	Principles of Gene Manipulation- R. W. Old & S. B. Primrose, 7^{th} Edition
Biological Chemistry	Chemistry of Biomolecules, Enzymes, Vitamins & Coenzymes, Bioenergetics and biological oxidation, Metabolism of Biomolecules, Photosynthesis	Principle of Biochemistry- Lehninger, Macmillan Worth Publication, 3rd edition
Microbiology	Fundamentals of Microbiology, A survey of the microbial world, Host-Microbe interaction, Microbes and Human disease, Environmental and applied microbiology	Microbiology-An introduction (8th edition)- Tartora, Funk & Cane-Pearson publishing house.
Ecology	Abiotic factors, Ecosystem ecology and energy flow, Community ecology and population ecology, Regional Ecology (Terrestrial and Aquatic), Regional Ecology (Terrestrial and Aquatic)	Concepts of Ecology by E J Kormondy Fundamentals of ecology by E. P. Odum
Plant Physiology	Transport and translocation of water and solutes, Essential elements and their function, Plant development and PGRs, Ascent of sap and translocation in phloem, Movement in plants	Plant physiology, 3rd edition by Salisbury & Ross- CBS Publisher and Distributor.
Bio-Physics	Chemical properties of basic unit of life, energy forces, bonds., Conformation of Biomolecules, Biological membranes and Biomechaniques, Physiochemical techniques to study biomolecules, X-ray crystallography, NMR, molecular modeling.	Biophysical chemistry by Cantor and Schimmel. Biophysics by Rodney Cotteril.
Developmental Biology	Model systems- Vertebrates, Invertebrates and Plants, Axis and germ layers, The mesoderm and early nervous system, Morphogenesis and cell differentiation, Organogenesis, germ cells and sex.	Principles of Development – Lewis Wolpert- Oxford University Press, 2nd edition
Cell Biology	Preview of cell, cellular membranous systems, Transport, Mitochondria, Chloroplast, energy transducing organelle, Golgi, Nucleus, Cytoskeletal network, Cell growth & proliferation, Cell Immunity	Cell and Molecular Biology- Philip Sheeler & Donald E. Bianchi. 3rd edition, John Wiley Publication.
Animal Physiology	Digestive and Respiratory system, Circulatory system, Excretory system, Nervous and Endocrine system, Body Immune system	Animal Physiology by Sherwood et al, 1st edition- Thomson Publication. Animal Physiology by Sherwood et al, 1st edition- Thomson Publication.

2. Chemical Engineering

Subject	Content	Reference Books
Chemical Process Calculations	Units and Dimensions, Chemical Equation and Stoichiometry, Thermodynamic properties of Gases, Vapors, Liquids and Solids, Steady and unsteady state mass and energy balances, Phase Equilibria (multiphase, multicomponent), reacting and non-reacting systems, recycle, bypass and purge calculations, Combustion Calculations.	Himmelblau, D. M. Riggs, J. B. "Basic principles & calculations in chemical Engg", PHI, 8th ed., 2015. Felder, R. M. & R. W. Rousseau, "Elementary Principles of Chemical Processes", John Wiley & Sons, Inc., 4th ed., 2011.
Fluid Mechanics	Fundamental Concepts and Fluid Statics, basic concept of Newtonian and non-Newtonian fluids, head losses, velocity and pressure drop calculation. Integral and Differential Analyses for Fluid Motion, Internal and External Fluid Flow and Flow through Packed & fluidized beds, Dimensional Analysis, flow meters, pumps and compressors.	R. W. Fox, A. T. McDonalds, and P. J. Pritchard, "Introduction to Fluid Mechanics", John Wiley and Sons Inc., 8th ed., 2013. W. L. McCabe, J. C. Smith, and P. Harriott, "Unit Operations of Chemical Engineering", McGraw Hill, Inc., 7th ed., 2014.
Chemical Engineering Thermodynamics	First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.	J. M. Smith, H.C. Ness, and M. Abbott, B Bhatt (Adapted), "Introduction to Chemical Engineering Thermodynamics", McGraw Hill Education, 7th ed., 2009. YVC Rao, "Chemical EngineeringThermodynamics", Universities Press, 1997. KV Narayanan, "A Textbook of Chemical Engineering Thermodynamics", Prentice Hall of India, 2nd ed., 2013.
Mass Transfer	Molecular diffusion and mass transfer coefficients Interphase mass transfer, heat and mass transfer analogies, design and operation of equipment for distillation, absorption, Adsorption, leaching, extraction, drying and adsorption, humidification, crystallization.	Treybal, R.E., "Mass Transfer Operations," 3rd ed., McGraw-Hill Education, 2012. Foust, A. S., Wenzel, L.A., Clump, C.W., Anderson, L.B., "Principles of Unit Operations," 2nd ed., John Wiley and Sons, New York, 2008.
Heat Transfer	Steady and Unsteady state heat conduction, Natural & Forced convection, Radiation, Condensation, boiling and evaporation, Heat Exchangers.	Holman, J. P., Bhattacharyya, S "Heat Transfer" 10th ed., McGraw-Hill, 2011. Frank P. Incropera, David P. DeWitt, "Fundamental of Heat & Mass Transfer" 6th ed., John Wiley & Sons, 2006. D. Q. Kern, "Process Heat Transfer", Tata McGraw Hill, 2001. McCabe & Smith, "Unit Operations of Chemical Engineering" 7th ed., McGraw Hill, 2014
Mechanical Operations	Properties and Handling of Particulate Solids, Mechanical Separations, particle size distribution, size reduction operation, operation of centrifuge and cyclones, filtration, agitation and mixing.	McCabe W. L., and Smith J. M., & Harriott P., Unit Operations of Chemical Engineering, 7th ed., McGraw Hill International Edition, 2014. J. M. Coulson, J. F. Richardson's Chemical Engineering, Vol. 1 (6th ed.,) & Vol. 6 (4th ed.,) Elsevier Butterworth-Heinemann, MA, USA, 2004 & 2005.
Chemical Reaction Engineering	Mole balances and reactor sizing, Rate laws and stoichiometry, Isothermal reactor design for single and multiple reactions, Analysis of laboratory reactor data, and reaction mechanisms for nonelementary reactions,	Scott Fogler "Elements of Chemical Reaction Engineering", PHI, 4th ed, 2015. O. Levenspiel, "Chemical Reaction Engineering", John Wiley, 3rd ed., 2006.

	Non isothermal reactor design, Heterogeneous reactors, Non Ideal reactors.	M. Smith, "Chemical Engineering Kinetics", McGraw Hill, 3rd Ed., 2013.
Chemical Process Technology	Inorganic chemical industries (sulphuric acid, phosphoric acid); Fertilizer industries (Ammonia, Urea, SSP, TSP); Natural product industries (Pulp & paper, Sugar, Oils & fats); Petroleum Refining and Petrochemicals; Polymerization industries (polyethylene, polypropylene, polyester synthetic fibers, PVC).	Moulin A J., Makkee, M., Diepen, A V., "Chemical Process Technology", 2nd ed., Wiley, 2013. Rao M G., Sittig M., "Dryden's Outlines of Chemical Technology for the 21st Century", East West Press, 3rd ed., 2006. Austin G T., Shreve R.N., "Shreve`s Chemical Process Industries", McGraw Hill, 5th ed., 2012.
Plant Design and Economics	Principles of process economics, depreciation calculation, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as evaporator, heat exchangers, multistage contactors.	James M. Douglas. Conceptual Design of Chemical Processes. McGraw-Hill International Editions (Chemical Engineering Series), McGraw Hill Book Company, New York, 1988. Max S. Peters, Klaus D. Timmerhaus, Ronald E. West, Max Peters. Plant Design and Economics for Chemical Engineers. 5th ed., McGraw Hill, New York, 2011. J. M. Coulson, J. F. Richardson's Chemical Engineering, Vol. 6 (4th ed.,) Elsevier Butterworth- Heinemann, MA, USA, 2005.
Process Dynamics and Control	Dynamic process modeling, Laplace transform, transfer functions, analysis of the dynamic behavior of chemical processes, Analysis and design aspect of feedback controllers (P, PI and PID), controller tuning, advanced control systems, measurement of process variables; sensors, transducers and their dynamics.	Stephanopoulos, G., "Chemical Process Control: An Introduction to Theory and Practice," Prentice-Hall, Englewood Cliffs, N.J., 2008 Seborg, D.E., Edgar, T.F., Mellichamp, D.A. and Doyle III F. J. "Process Dynamics and Control," 4th ed., Wiley, 2016. Coughnowr, D. R., Leblanc S., "Process Systems Analysis and Control," 3rd ed., McGraw-Hill, 2013.

3. Chemistry

Subject	Content	Reference Books
Physical Chemistry	Basic principles and applications of quantum mechanics, angular momentum, hydrogen atom, atomic structure, chemical bonding, variational and perturbational methods, pure rotational spectroscopy, vibrational spectroscopy, vibrational-rotational spectroscopy, Raman spectroscopy, electronic spectroscopy, nuclear magnetic resonance spectroscopy, electron spin resonance spectroscopy, mass spectroscopy, fluorescence spectroscopy Concepts and laws of thermodynamics, entropy, free energy, calculation of changes in thermodynamic properties, partial molar properties, ideal and real gases, ideal and non-ideal solutions, electrolytic solutions, colligative properties, phase equilibria, chemical equilibria, electrochemistry and applications, kinetic theory of gases, statistical thermodynamics Chemical kinetics, rate laws, order and molecularity, determination of reaction mechanism, Arrhenius equation, theory of reaction rates, concept of catalysts, elementary reactions, consecutive elementary reactions, unimolecular reactions, polymerization kinetics, photochemical processes, quantum yield, enzyme kinetics, thermodynamic and kinetic control, physical and chemisorption, molecular interactions,self-assembly and transport processes	1. Donald A. McQuarrie, „Quantum Chemistry", University Science Books (First Indian Edition 2003, Viva Books Private Limited). 2. Ira N. Levine, „Quantum Chemistry", Pearson Education Inc. (2000) (First Indian Reprint, 20033. 3. P.W. Atkins and R.S. Friedman, „Molecular Quantum Mechanics', 3rd Ed. OUP (1997). [4th ed. Has come out]. 4. F.L. Pillar, „Elementary Quantum Chemistry", 2nd ed., McGraw Hill (1990). 5. John P. Lowe, „Quantum Chemistry", 2nd ed., Pearson Education Inc. 6. Ira N. Levine, Physical Chemistry, Tata McGrawHill, 2002, 5th edition 7. Donald A. McQuarrie & J. D. Simon, „Molecular Thermodynamics', Viva Book Pvt Ltd., New Delhi, 2004 8. R. C Srivastava, S K Saha, A K Jain, „Thermodynamics', 2004
Inorganic Chemistry	VSEPR Model, VB Theory, Ionic Crystal Structure, Structure of Complex Solids, Electronegativity, Acid- Base Chemistry, Chemistry in Aqueous and Non- Aqueous Solvents, Periodicity, Chemistry of transition metals, Redox chemistry. Character Table and its Applications in Infrared and Raman spectroscopy and in Bonding; Coordination Chemistry: Bonding - Valence Bond, Crystal Field, and Molecular Orbital theories; Complexes - Nomenclature, Isomerism, Coordination Numbers, Structure, Electronic Spectra, Magnetic Properties, Chelate Effect; Reactions - Nucleophilic Substitution Reactions, Kinetics, Mechanisms; Organometallic Chemistry: Structure and Reaction of Metal Carbonyls, Nitrosyls, Dinitrogens, Alkyls, Carbenes, Carbynes, Carbides, Alkenes, Alkynes, and Metallocenes; Catalysis by Organometallic Compounds; Stereochemically Non-Rigid Molecules. Bio-inorganic chemistry; metalloenzymes; metalloproteins; role of alkali and alkaline earth metal	1. Chemical Application of Group Theory, F. A. Cotton, 3rd edition, John Wiley and Sons, Inc. 2011. 2. J. A. Cowan, "Inorganic Biochemistry An Introduction", Wiley-VCH, 2nd edition 3. Inorganic Chemistry – Principles of Structure and Reactivity, Huheey, J. E.; Keiter, E. A.; Keiter, R. L.; Medhi O. K.; 4th Edition, Pearson. 4. Concise Inorganic Chemistry, Lee, J.D. 5th Edition, Wiley India Edition. 5. Inorganic Chemistry, Shriver, D.F.; Atkins, P.W.; Overton T. L., Rourke, J. P.,
	ions, iron, copper, zinc, molybdenum etc. in life processes; Basic concepts in electronic, magnetic and photonic materials and nanomaterials.	Weller, M. T., Armstrong, F. A. 4th edition, Oxford.

Organic Chemistry	Structure and Reactivity of Organic Compounds: IUPAC nomenclature of organic compounds, Reactive intermediates (carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes), Aromaticity (Benzenoid and non-benzenoid compounds), Aliphatic & Aromatic Nucleophilic and Electrophilic Substitutions, Addition Reactions (carbon-carbon and carbon-hetero- multiple bonds) Elimination Reactions, Neighboring Group Participation Chemistry of Organic Compounds: Chemistry of functional groups, Structure, property and reactions of five and six membered heterocyclic (O, N and S) compounds, Organometallic compounds in organic synthesis, Natural products (carbohydrates, alkaloids, terpenes, amino acids). Stereochemistry of Organic Compounds: Stereochemistry (isomerism, chirality, origin of optical activity, stereochemistry of cyclic compounds, resolution), Selectivity (chemo-, regio-, and stereoselectivity), Conformations and configurational analysis of acyclic and cyclic compounds, Resolution and other asymmetric induction methods, Name reactions and rearrangements. Retrosynthetic Analysis: Disconnection approaches, Protecting Groups, Umpolung of reactivity, Ring synthesis and synthesis of Heterocyclic compounds Pericyclic Reactions and Photochemistry: Orbital symmetry, Electrocyclisation, Cycloaddition, Sigmatropic rearrangements and other related concerted reactions, Principles and applications of photochemical reactions in organic chemistry Spectroscopy of Organic Compounds: Structural elucidation of organic compounds using UV, IR, NMR (1H & 13C), Mass Spectrometry	1. March Jerry, Advanced Organic Chemistry, JohnWiley & Sons, 4th edition, 1992. 2. Morrison and Boyd, Organic Chemistry, Prentice & Hall, 6th edition, 1992. 3. William Kemp, "Organic Spectroscopy", Macmillan, 3rd ed. 1991. 4. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press. 5. Raj K Bansal, heterocyclic Chemistry, fifth edition (TB), New Age International publishers. 6. I. L. Finar, Organic chemistry Vol. 2, 5thEd.; Pearson 7. Stuart Warren, Designing Organic Syntheses: A Programmed Introduction to the Synthon Approach, John Wiley and sons Ltd., 1978. 8. W. Graham Solomons and Craig B. Fryhle, „Organic Chemistry", 8thEdition,John Wiley & Sons, Inc. New York, 2004. 9. F. A. Carey, Organic Chemistry, 5th Edition,Tata McGraw-Hill Publications Company Ltd., 2003. 10. P. A. Bruice, Organic Chemistry, 3rd Edition, Reason Edution, Inc. 2001.
Analytical Chemistry	Instrumental methods of analysis: Magnetic Resonance Spectroscopy (1H NMR, 13C NMR, EPR), IR Spectroscopy, Mass Spectrometry, Ultraviolet and visible spectroscopy, fluorescence spectroscopy, chromatography and other separation techniques, Structure Resolution by combination of techniques. Chemical experimentation: Chemical Experimentation: Functional group identification and synthesis of organic compounds, Chromatography techniques (TLC & HPLC), Separation and qualitative analysis of mixture of organic Compounds. Acid base titrations, Complexometric titrations, Study of kinetics of chemical reactions, Determination of partition function, Adsorption isotherm, Synthesis and characterization of nanomaterials	William Kemp, "Organic Spectroscopy", Macmillan, 3rd ed, 1991 Vogel's textbook of practical organic chemistry 5th edition

4. Civil

Subject	Content	Reference Books
Mechanics and Strength of Materials	Fundamental principles of Mechanics, Introduction to Mechanics of Deformable Bodies, Forces and Moments Transmitted by Slender Members, Stress and Strains, Stresses due to Bending, Torsion.	(1) An Introduction to Mechanics of Solids, Second Edition with SI units Crandall/Dahl/Lardner, Tata McGraw Hill Publication, New Delhi. (2) Mechanics of Materials(In SI units) , Beer, Johnston, Dewolf and Mazurek, Tata McGraw Hill Publication, New Delhi
Analysis of Structures	Statics of Structures and Degree of Indeterminacy, Analysis of Determinate and Indeterminate Structures (trusses, beams, frames, cables and arches), Deflection of beams and Frames, Influence lines and its Applications, Introduction to Matrix Methods of Structural Analysis.	Structural Analysis by R.C. Hibbler, Pearson, India. Fundamentals of Structural Analysis by Kenneth M. Leet & Chia-Ming Uang, McGraw Hill Publications,New Delhi.
Design of Concrete Structures	Ingredients for reinforced concrete, Design of concrete Mix, Design philosophies, Design of singly and doubly reinforced rectangular and flanged sections for Flexure using Working stress and Limit State Design approach, Design for bond, anchorage and development length, Design of beams for Shear, serviceability requirements, Design of one-way slab, two-way slab and staircase, Design of columns.	Limit State Design of Reinforced Concrete, By: P. C. Varghese, PHI, New Delhi. Reinforced Concrete Design by Pillai and Menon, Tata McGraw Hill, Publication, New Delhi. Reinforced Concrete Design by S. N. Sinha, Tata McGraw Hill, Publication, New Delhi. Design of Concrete Structures by Nilson, Darwin and Dolan, Tata McGraw Hill, Publication, New Delhi. Design of Concrete Structures, by J. N. Bandyopadhyay, Prentice-Hall of India, New Delhi.
Design of Steel Structures (Limit State Design)	Steel Design Specifications and Connections, eccentric and moment connections, Design of Tension and Compression Members, Design of beams and plate girders, Introduction to plastic analysis and design.	Design of Steel Structure by N. Subramaniam, Oxford University Press. Teaching Resource for Structural Steel Design, Vol. 1, 2, 3: Institute for Steel Development and Growth, Kolkata.
Transportation Engineering	Highway alignment; Geometric design of highways: Cross-sectional elements, sight distances, horizontal and vertical alignment designs, , Highway Materials - Desirable properties of bitumen, aggregates, soil and bituminous paving mixture design using Marshall's specifications; Design factors for flexible and rigid pavements, Pavement Design: Factors controlling flexible and rigid pavement designs, design of flexible pavement using IRC: 37, design of rigid pavements using IRC: 58; Overlaydesign using IRC:81, Traffic Engineering: Traffic studies on flow, speed, travel time - delay and O-D study, EPCU concept, V/C ratios and Level of Service Concepts, , traffic control devices - Signal design by IRC and Webster's methods, Types of intersections and channelization.	1. Khanna, S.K, Justo, A and Veeraragavan, A, 'Highway Engineering', Nem Chand & Bros. Revised10th Edition, 2014 2. Kadiyali L.R. and Lal N B, Principles and Practices of Highway Engineering; 4th Edition; KhannaPublishers, New Delhi, 2011 3. Design Codes: IRC 37, IRC 58, IRC 81, MoRTH Code of Provision

Surveying	Chain Survey, Compass Survey & leveling, Theodolite, Tachometric surveying & Traversing, Curve Ranging, Contouring & Plane Tabling, Trigonometric Leveling, Areas and Volumes, Geodetic surveying, Total Stations. Introduction to advanced surveying techniques like DGPS, GIS.	Arora K R, Surveying (in SI Units), Standard Publisher, Vol 1, II and III, 13th Edition, 2015PunmiaB C, Surveying, Laxmi Publishers, Vol 1, II and III, 17th Edition, 2016 Duggal S K, Surveying, Tat McGraw Hill, New Delhi, Vol. I and II, 4th Edition, 2013
Construction Planning and Technology	Concrete ingredients- cement, aggregates, chemical and mineral admixtures. Mix design, Fresh and hardened characteristics, Properties, testing and applications of concrete, Masonry materials, Timber, Bituminous materials, Steel, Non-ferrous metals and alloys, Ceramics, Glass, Polymeric materials, Paints, distemper and varnishes, Construction planning and scheduling, Advanced construction techniques.	Arora. S.P. & S.P. Bindra. 'A Textbook of Building construction,' Dhanpat Rai & Sons Peurifoy, R.L., & C.L., Schexnayder, 'Construction Planning, Equipment and Methods', T.M.H.. Gupta R., Construction Planning & Technology', CBS. Duggal, S.K. "Building Materials" New Age International Pvt. Ltd., New DelhiGhambir, Concrete Technology, Tata McGraw-Hill Publishing Company Ltd.
Soil Mechanics and Foundation Engineering	Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Indian standard soil classification system; Permeability - one dimensional flow, Darcy's law; Seepagethrough soils - two-dimensional flow, flow nets, uplift pressure, piping; Principle of effective stress, capillarity, seepage force and quicksand condition; Compaction in laboratory and field conditions; One- dimensional consolidation, time rate of consolidation; Shear strength of soil using various tests, effective and total shear strength parameters, characteristics of clays and sand. Sub-surface investigations - scope, drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes - finite and infiniteslopes, method of slices and Bishop's method; Stress distribution in soils - Boussinesq's and Westergaard's theories, pressure bulbs; Shallow foundations - Terzaghi's bearing capacity theory and determination of bearing capacity as per IS:6403, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.	Ranjan, G. and Rao, A.S.R.,(2016) "Basic and Applied Soil Mechanics" New Age International Publishers.
Water and Wastewater Treatment	Water and wastewater characteristics; Basic unit processes and operations for water treatment; Drinking water standards; Distribution of water; Sewage and sewerage treatment; Primary, secondary and tertiary treatment of wastewater, effluent discharge standards; Sludge disposal.	Water Supply Engineering and Wastewater Engineering by B. C. Punmia. Laxmi Publications (P) Ltd., New Delhi. Water Supply Engineering and Sewage & Wastewater Disposal Engineering by S. K. Garg. Khanna Publishers, Delhi, Environmental Engineering by H.S. Peavy. McGraw Hill International editions.

Water Resource Engineering	Fluid Mechanics and Hydraulics: Fluid Properties, Fluid pressure and measurement, Hydrostatics, Buoyancy, Fundamentals of fluid flow and Kinematics of fluid in motion, Conservation of mass, momentum and energy, Analysis of flow through pipes, Laminar flow, Study of flow pattern through Orifices and Mouthpieces, Notches and Weirs, Dimensional analysis and similitude, Boundary Layer Theory, Flow past immersed bodies, turbulent flow through conduits; analysis of closed-conduit hydraulic systems including pipes, valves, fittings, and pumps, pipe networks and analysis: Hardy cross method and linear graph method; Open channel hydraulics: uniform and non-uniform flow; analysis and design of hydraulic systems; Analysis of impact of jets; Fluid machinery: theory, performance and application of Pumps and Turbines. Hydrology: Hydrological Cycle and Budget; Precipitation Measurement and Analysis; Hydrologic Abstractions; Stream Flow analysis and concepts of hydrograph; Hydrologic measurements; Statistical analysis in hydrology; Ground Water hydrology; Flood Routing; Introduction to dams, spillways, diversion head-works and distribution systems, Reservoir planning and multi-purpose reservoirs, hydropower engineering.	Modi P.N. and Seth S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, Post Box 1074, New Delhi. Patra K.C., “Hydrology and Water Resources Engineering”, Narosa Publishing House. Mays L.W., “Water Resources Engineering”, John Wiley and Sons.

5. Computer Science and Information Systems

Subject	Content	Reference Books
Data Structures and Algorithms	Introduction: Data Abstraction, Data Modeling, Data Representation, Abstract Data Types, Algorithm Analysis and Order Notation, Time and Space requirements, Recursion and Iteration Linear Structures: Lists, Random vs. Sequential Access, Restricted Access Lists. Dictionaries-Searching and Ranking: Sorting Algorithms, Searching, Hashing, Hash Tables, Bloom Filters, Non-Linear Data Structures: Binary Trees, Binary Search Trees (BST), B-Trees, Tree Traversals, Heaps and Tries, Application of Trees, Graph Traversals-Representation, Connectivity, Paths, Connected Components Weighted Graphs- Modelling, Shortest Path, Minimal Spanning Tree.	Goodrich, Michael T., and Roberto Tamassia. Algorithm design: foundation, analysis and internet examples. John Wiley & Sons, 2006. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms 3rd Edition, MIT press, 2018.
Operating Systems	Introduction to OS: OS architecture and its components, Special purpose systems, System structures Process: Process Concept, Process scheduling, operations on processes, Inter Process Communication (IPC) Process scheduling algorithms, Process Synchronization Critical section problem, Semaphores, Monitors, Synchronization Hardware Deadlock: Characterization, Deadlock detection, Prevention, Avoidance, Recovery from deadlocks Memory management, Allocation, Concept of segmentation & H/W support in Intel Processors. Concept of Paging & H/W support in Intel Processors, Virtual Memory management, Page replacement algorithms, Frame allocation and Thrashing Secondary Storage Structures & Management, File Systems	Stallings, William. Operating systems: internals and design principles. Boston: Prentice Hall, 2012. Silberschatz, Abraham, Peter Baer Galvin, and Greg Gagne. Operating system principles. John Wiley & Sons, 2006.
Computer Organization & Architecture	Introduction, MIPS Architecture & Instruction Set, Computer Arithmetic, Floating Point Arithmetic, Role of Performance, Data path Design, Control Hardware, Exceptions & Microprogramming, Memory Organization- Introduction, Cache Memory Organization, Cache Performance, I/O Organization, Pipelining – Design Issues, Data Hazards, Control Hazards, Static Branch Prediction, Dynamic Branch Prediction, Advanced Concepts in pipelining, Modern Processors	Patterson, David A & J L Hennenssy, Computer Organisation & Design, Elsevier, 4th Ed., 2009. W. Stallings, Computer Organisation & Architecture, PHI, 9th ed., 2012
Database Systems	Introduction to Database Systems, Data Modelling: ER Modelling, Relational Modelling: ER to Relational Model, Database Design through functional dependencies, Normalization: 1NF, 2NF, 3NF, BCNF, Multi-valued dependencies. Query Languages: Relational Algebra, SQL Data Storage Indexing: File Organizations, RAID, Indexing Structures (tree-based, hash-based) Query Processing and Optimization: Cost-Based Optimization and Heuristic-Based Optimization. Transaction Management: Serial Schedule & Serializability, Recoverability & Cascadeless Schedules Concurrency Control and Crash Recovery: Locking, Time-Stamping, Log-Based, Shadow Paging.	Ramakrishna R. & Gehrke J, Database Management Systems, 3e, Mc-Graw Hill. Hector G Molina, Jeffrey D.Ullman and Jennifer Widom, Database Systems – The Complete Book, Pearson Education, 2e.

Software Engineering	Introduction: Evolving role of S/W, Software Myths, different development philosophies: sequential versus iterative, overview of various SDLC models/methodologies. Software Lifecycle Models: Build and Fix Model, Waterfall Model, Increment Process Model, Rapid Application Development (RAD) Model, Evolutionary Process Models, Unified Process, Selection of a Life Cycle Model Requirement Specifications: Algebraic Specifications, Functional and non-functional requirements, SRS, requirements engineering processes, requirements elicitation and analysis, requirements validation, management. Software Design: Modularity, high-level and detailed design, layered design, cohesion and coupling, function-oriented design, SA/SD (structured analysis/structured design), data flow diagrams (DFDs), constructing DFDs, structure chart, object- oriented analysis and design (OOAD), UML Concept, (rational) unified process, patterns. Software Project Planning: Size Estimation: Lines of Code (LOC), Function count, Cost estimation, Models: Constructive Cost Model (COCOMO), COCOMO II, Putnam resource allocation model, Halstead's software science, Software risk management. Implementation and Testing: Rationale between requirements and testing, verification versus validation, black box and white box testing techniques. Software Testing Methodologies: Functional Testing: Boundary value analysis, equivalence class testing, Cause Effect Graphing Technique and other topics based on students' interest.	Sommerville I, Software Engineering, Pearson Education, 10th Edition, 2017. Pressman, R.S., Software Engineering: A Practitioner's Approach, 7th (Alternate) Edition, McGraw Hill International Edition, 2010

6. Electrical & Electronics

Subject	Content	Reference Books
Electrical Sciences	Basic Circuit elements, sources and laws, Circuit analysis Techniques & Theorems, Time-domain analysis of 1st & 2nd Order Circuits, AC Circuit Analysis, Important Power Concepts, Power factor correction, Single phase and Three- phase Circuit Analysis, Frequency response and Resonance, Semiconductors: Construction, operation and application of Junction Diode, Zener Diode, Transistor (BJT's), JFET's and MOSFET, Ideal operational amplifiers configuration, Magnetic Circuits.	Leonard S Bobrow and Navneet Gupta "Foundation of Electrical Engineering" Oxford University Press,Asian Edition, 2015.
Electromagnetics	Maxwell's équations in free space and in time-varying fields, boundary conditions, wave equation, Poynting vector; Plane waves in dielectric and conducting media, wave reflection, refraction, and polarization, phase and group velocity, skin depth; Transmission lines, Smith chart and its application in impedance matching calculations, Basics of guided wave propagation, Antennas and radiation, antenna parameters, Hertziandipole, half-wave dipole, loop, helical and hornantennas, antenna arrays, Radio Link and Friis Formula.	John D Kraus and D.A. Fleisch, "Electromagnetics & applications". 5th Edition, McGraw-Hill, New Delhi
Digital electronics	Number systems & Codes, Boolean algebra & Simplification, Digital Logic Families, Combinational logicDesign – Decoders, Encoders, MUX, DeMUX, Arithmetic Circuits, Sequential Logic design- Flip- flops, State machines, ASM, Counters & Registers, and PLDs & FPGAs & Computer Organization.	M. Morris Mano, " Digital Design", PHI, 3rd Edition, 2002.
Signals & systems and Digital Signal Processing	Continuous-time and discrete-time signals and systems, Sampling and reconstruction, Properties of linear time-invariant (LTI) systems, Linear convolution, Fourier series (CTFS, DTFS), Fourier transform (CTFT, DTFT), Laplace transform, Z-transform, System analysis and frequency response. Discrete Fourier Transform, Fast Fourier Transform, Analog filters, Digital filters (FIR and IIR), Linear estimation and prediction, Adaptive filters, Multi-rate signal Processing.	1. B P Lathi "Principles of Signal Processing and Linear Systems" Oxford University Press, Internationalversion, 2009. 2. Alan V. Oppenheim, Alan S. Willsky, "Signals and Systems," Pearson Education Ltd., 2nd edition,2015. 3. Sanjit K. Mitra "Digital Signal Processing-A computer-based approach" McGraw Hill education, 4th Edition, 2013.
Electrical machines	Transformer: Constructional features, equivalent circuit and phasor diagram - regulation and efficiency, parallel operation. Three phase transformer connections; Harmonic in transformers; Testing; Phase conversion; Autotransformer. D.C Machines: Construction, armature windings, armature voltage and torque equations, classification. D.C generators, performance characteristics; D.C motors - torque/speed characteristics, speed control and braking. Testing and efficiency. Induction machines: Constructional features and rotating magnetic field. Circuit model and phasor diagram. Steady state characteristics. Testing, starting and speed control. Time harmonics and space harmonics. Wound rotor induction motors, Single phase induction motors - classification and equivalent circuit. Synchronous machines: Constructional features; synchronous generators and motors; equivalent circuit and phasor diagram; power and torque characteristics and capability curves. Parallel operation. Salient pole synchronous machine - phasor diagram and determination of synchronous reactances; starting and speed control of synchronous motors.	L K Maheshwari & M M S Anand "Analog Electronics" PHI Private Ltd. 2005.Adel S Sedra & K C Smith" Microelectronic Circuits" OUP, 5th edition, 2005.

Control system and power electronics	Mathematical model of physical systems: Differential equations, Block diagram, signal flow graph, transfer function, feedback characteristics of control systems, control systems components, Time response analysis, stability, Root locus concepts, frequency response (Bode plots, Polar plots, Nyquist plots), state space analysis and compensation concepts. Line frequency Uncontrolled/Controlled AC-DC Converter (Rectifier); DC-DC Switch- Mode Converters; Switch- Mode DC-AC Converters (Inverters).	
Power systems	Power system concepts, per unit system, Transmission line parameters and modeling, Characteristics and performance of lines, Load flow studies, Optimal system operation, Automatic Generation and voltage Control, Power system fault analysis, Power Systems stability.	
Analog electronics	Operational amplifier basics, ideal and practical Op-amp configurations, special purpose linear Op-amp circuits: instrumentation amplifiers, isolation, programmable, negative feedback amplifiers etc., Active filters, IC filters; non-linear operational amplifier circuits, analog multipliers, precision and wave shaping circuits, comparators and Schmitt triggers and applications, Signal generators: sinusoidal and non- sinusoidal oscillators, integrated circuits timers. function generators, PLL, Voltage Regulators; voltage regulator IC, switched capacitor voltage converters, switching regulators, Power amplifiers and output stage circuits, IC power amplifiers, high frequency amplifiers, tuned amplifiers.	
Electronic devices and microelectronics circuits	Semiconductor materials and their properties, Carrier transport and excess carriers in semiconductors; Single p-n junction devices- rectifier, Zener diodes, switching diodes, microwave diodes, optoelectronic devices, Bipolar junction transistors; JFET; MOSFET; MOS and CMOS devices; Basic device fabrication steps and techniques and introduction to ICs. Basic single and two stage transistor BJT and MOSFET amplifier; current mirrors and current sources; active load biasing in integrated circuits, Voltage sources and voltage references, differential and multistage amplifiers with and without feedback; frequency response and frequency compensation, Operational amplifiers-2 stage, stability analysis and compensation techniques.	B G Streetman & Sanjay Banerjee" Solid state Electronic Devices" PHI Pearson Edu, 6th ed.,2006. Adel S Sedra& K C Smith" Microelectronic Circuits" OUP, 5th edition,2005.
Microprocessor	Introduction to Intel 80x86 processor ISA (8086-80486) , Assembly programming, Programmers model of processor, processor architecture; Instruction set, modular assembly programming using subroutines, macros etc. Timing diagrams, Concept of interrupts: hardware & software interrupts, Interrupt handling techniques, Interrupt controllers, Types of Memory & memory interfacing, Programmable Peripheral devices and I/O Interfacing, DMA controller and its interfacing, Serial Interface – PCI Buses, RISC Vs CISC, Cache Memory Organization, Concept of multicore microprocessors, Design of processor based system.	Barry B Brey, C R Sarma, The Intel Microprocessors. Pearson, 6th Ed. 2005. Douglas V Hall, Microprocessor and Interfacing, TMH, Second Edition.
Communication systems	Signals & Signal Space, Analysis and transmission of signals, Continuous Wave Modulation and Demodulation - AM, FM, PM, Sampling, A/D and D/A conversion, Pulse Shaping and Transmission, Synchronization & Multiplexing Techniques, Random Process and Spectral Analysis, Bandpass Digital Modulation and Demodulation Schemes, Distortive and Noisy Channels, Fading Channels, Performance analysis of Communication systems, Communication Link Analysis, Information Theory, Source Encoding, Error-control Coding, Modulation and Coding Trade-offs, Spread Spectrum Communication Systems, Multiuser & Multicarrier Communication Systems.	B. P. Lathi and Zhi Ding. Modern Digital and Analog Communication Systems. 4th ed. Oxford University Press 2010. Simon Haykin and Michael Moher. Communication Systems. 5th ed. John Wiley & Sons 2009. John G Proakis and Masoud Salehi. Digital Communications. 5th ed. McGraw-Hill 2008. Andrea Goldsmith. Wireless Communications. Cambridge University Press 2005. John G. Proakis and Masoud Salehi.

		Communication Systems Engineering. 2nd ed. Pearson Education 2002. Herbert Taub and Donald L. Schilling. Principles of Communication Systems. 2nd ed. McGraw-Hill Higher Education 1986. Machining
Telecom switching	Switching Systems, Signaling Systems and Standards, Voice Digitization, Digital Transmission and Multiplexing, Signal Encoding Techniques and Transmission Media, Synchronization, Digital Switching - Space and Time Division Switching, Data and Asynchronous Transfer Mode Networks, Circuit Switching, Packet Switching, Routing, Data Transfer Protocols, OSI Model, Networks Topologies - LAN, MAN, WAN, Internetworking and Applications, Network Control and Management, Subscriber Access Techniques - ISDN, DSL, Wireless Connectivity, Cellular Networks and Mobile Telephony, Fiber Optic Communication Systems, Optical Network Standards, Telecommunication Traffic Engineering and Analysis Delay Systems, Voice-over-IP.	John C Bellamy. Digital Telephony. 3rd ed. John Wiley & Sons 2003. Roger L. Freeman. Telecommunication System Engineering. 4th ed. John Wiley & Sons 2004. Thiagarajan Viswanathan and Manav Bhatnagar. Telecommunication Switching Systems and Networks. 2nd ed. Prentice-Hall India 2015. Behrouz A. Forouzan. Data Communications and Networking. 5th ed. McGraw Hill Education (India) 2013. William Stallings. Data and Computer Communications. 8th ed. Pearson Education 2007.

7. Economics

Subject	Content	Reference Books
Principles of Economics	Demand, Supply, Elasticity, Consumer Behavior, Analysis of Production and Cost Analysis, Markets, Basics of Macroeconomics, Economics of Public Goods	Case and Fair, Principles of Economics, Pearson Education, 2012
Fundamentals of Finance & Accounting	Basics of Accounting, Financial Statements and Analysis, Introduction to Securities, markets and analysis, Banking System, RBI, Non-bank financial intermediaries, Markets for Future, Options & Derivatives; Foreign Exchange Markets Capital market theory, Security valuation, Portfolio evaluation measures, Accounting analysis, Strategic analysis, Corporate strategies, Financial analysis, Valuation, Time value of money, Cost of capital, Capital structure,Dividend policy, Capital budgeting decision, Bondvaluation, Stock valuation, Working capital management, Introduction to Risk & Derivatives Markets and Futures markets, Determination of forward and futures prices and Interest rate Futures, Hedging Strategies using Interest, Currency, Commodity, Stock and Index Futures, Mechanics of Swap contracts (Equity and Currency), Mechanics of Options Markets, Properties of Stock Options, Trading Strategies Involving Options, Option Pricing, Basic Greek Letters	Horngren, Sundem, and Elliott, Introduction to Financial Accounting, Pearson Education India Ltd. 8th ed. 2004 Bhole L.M, Financial Institution & Market Structure: Growth & Innovation, Tata McGraw Hill, 4th ed. 2004.
Microeconomics	Theory of Consumer Behaviour, Topics in Consumer Theory, Theory of Firm, Theory of Market Structure, General Equilibrium, Welfare Economics, Externalities, Common & Public Goods	Henderson J M and Quandt R E , Microeconomic Theory : A Mathematical Approach , McGraw Hill 3rd ed. 1980.
Macroeconomics	Macroeconomic System- Measurement, I-O System, Flow of Funds, Keynesian System – Demand, Money, Interest, Income, Output, Inflation& Unemployment, Money Supply, Consumption and Investment, Consumption and Investment	Froyen, Richard T Macroeconomics: Theories & Policies Pearson Education, Latest Edition.
Econometrics	Basics of Statistics, OLS, k-variable Linear Equation, General Linear Model, Violation of classical Assumptions, Heteroscedasticity, Autocorrelation, Multi co linearity, ARIMA Model, Time Series Analysis, Simultaneous Equation System	Johnston J and John Dinardo, Econometric Methods McGraw Hill International, 4th ed. 1997.
Money Banking & Financial Markets	Fundamentals of Financial Markets, Money and its Functions, Money Markets, Financial Markets and Financial Institutions, Foreign Exchange Markets,	Mishkin, Frederic S, Stanley G Eakins, Financial Markets and Institutions,

	International Financial System, Banking Business, Role of Central Bank in conduct of Monetary Policy, Management of Financial Institutions, Risk Management and Financial Derivatives.	Pearson Education, 8th Edition, 2016.
Public Finance – Theory and Practice	Scope of Public Finance, Allocation, Distribution & Public Choices, Equity in Distribution, Public Choice & Fiscal Policy, Public Expenditure – Structure, Growth & Evaluation, Public Revenue, Principles of Taxation, Role of Fiscal Policy in India, Budgeting in India	Musgrave, R.A and Musgrave, P.B Public Finance: Theory and Practice McGraw Hill Book Co. 1999.
Economics of Growth and Planning	Economic Growth Models – Harrod-Domar, Neo- classical, Two sector Models, The Feldman Model of Economic Growth, Samuelson Model of Economic Growth, Kaldors Model of Income, Population, Environment, Inequality and Development. Issues of Development Economics.	Jones H. G. An Introduction to Modern Theories of Economic Growth, McGraw Hill, Kogakusha Ltd. 1976., Devraj Ray Development Economics OUP, Delhi 1998
International Economics	International Economics, Trade Theories, International Trade – Comparative Advantage, Heckscher –Ohlin (H-O) Model, Modern Theories of International Trade, Commercial Policies; Tariffs, Quotas, FDI, BOP, GATT, WTO, International Monetary System	Salvatore. D. International Economics WSE 9th ed. 2014
Issues in Indian Economy	India‟s Economic Growth & Development, Significant Aspects of Indian Economy – Agriculture, Infrastructure, Private & Public Sector, Industrial Growth, Import- Exports, Unemployment, Commercial Banking & Finance, Inflation& Income Growth, Money Supply, Monetary Control, India's Trade, External Aid, Public Debt	Agarwal. A. N, Indian Economy – Problems of Development & Planning Wishwa Prakashan, A division of New Age International(P) Ltd.,2005

8. Humanities & Social Sciences

Subject	Content	Reference Books
Media Studies	Cinematic Art, Cinematic Adaptation, Understanding News, Current Affairs, Mass communication, Advertising, Media Writing, Content Design, Short Film Making	Hartley, J. Understanding News. London: Routledge. 1991 2nd Ed The Oxford Guide to Film Studies. Richard Dyer et al. A&C Black Publishers Ltd. London, 2008 Belch, George E. and Michael A. Belch. 1998. Advertising and Promotion. Sixth Ed. New Delhi: Tata McGraw-Hill.
Communication	Business Communication, Conflict Management, Technical Communication	Lesikar and Flately. 2005. Basic Business Communication. New Delhi: Tata McGraw Hill 10th ed. The Dynamics of Conflict Resolution, San Francisco: Wiley Company, 2000
Phonetics, Language & Literature	English Language Teaching, English Usage, Phonetics and Language, English Literature: Elizabethans and Augustan, Pre-romantics and Romantics, Victorian Literature, Twentieth Century Literature: Poetry and Drama, Twentieth Century Literature: Prose and Fiction, Indian Writing in English, Applied Linguistics, American Literature, Women's Writing, Postcolonial Literature	The Oxford Companion To English Literature. A Critical History of English Literature (Vol – I & II) by David Daiches. Studying English Literature (A Practical Guide) by Tory Young. Murphy, R. (2012). English grammar in use. Cambridge: Cambridge University Press. Richards, J. C., & Rodgers, T. S. (2001). Approaches and methods in language teaching. Cambridge: Cambridge University Press. Nunan, David, & Newbury House Teacher Development. (1999). Second language teaching & learning. Boston, Mass: Heinle & Heinle.
Music	Logic and science working behind music, Schools of musical training, Musical forms and styles	Sangeet Ratnakar by Sharang dev
Other HSS areas	Test can also be conducted in these subjects depending upon the applications: Sociology, Public Policy, Gender Studies, History, Psychology, Philosophy, Political Science, Professional Ethics, Education	
Digital Humanities	"A Companion to Digital Humanities". Schreibman, S., Siemens, R., Unsworth, J. (Eds). Blackwell Companions to Literature and Culture. Paperback Edition, 2007. (Available freely online at http://www.digitalhumanities.org/companion/) "A Companion to Digital Literary Studies". Schreibman, S., and Siemens, R., (Eds). Blackwell Companions to Literature and Culture. 2008. (Available freely online at http://www.digitalhumanities.org/companionDLS/)	
Philosophy	Soccio, Douglas J. 2001. Archetypes of Wisdom: An Introduction to Philosophy. Wordsworth. Moore, Brroke Noel and Burder, Kenneth. 2005. Philosophy: The Power of Idea. Tata McGraw-Hill. The Essentials of Indian Philosophy, M. Hiriyanna, 2015, Motilal Banarsidass Publishers	
General Psychology	Robert A Baron, Psychology, Prentice Hall of India, 2005	
Cognitive Psychology	Levitin, D. J. 2002. Foundaitons of Cognitive Psychology. The MIT Press. Martline, M.W. 2013. Cognitive Psychology, John Wiley & Sons.	

Educational Psychology	Educational Psychology, 2nd edition, The Saylor Foundation (https://www.saylor.org/site/wp-content/uploads/2012/06/Educational- Psychology.pdf)
Education	Contemporary Issues in Higher Education, 2nd Edition, Richard Fossey, Kerry Brian Melear, and Joseph C. Beckham, eds. (2011) Issues and Challenges on Higher Education, (Eds. Doris Phillips Singh and Naveen Sameul Singh), Words Worth, 2012.
Organizational Behavior	Robins, Stephen; Judge, Thimonthy A; and Sanghi, Sooma. 2010. Essentials of Organizational Behavior. Pearson Education India
Spiritual Intelligence	Zohar and Marshall, Spiritual Intelligence The Ultimate Intelligence, Bloomsbury, 2001. Schuller, Peter A. ,Spiritual Intelligence, Author House, 2003.
Political Science	Robert E. Goodin, Philip Pettit and Thomas Pogge (Eds.) 2007. A Companion to Contemporary Political Philosophy (2nd edition), Oxford: Blackwell. Goodwin, Barbara (2014) Using Political Ideas (6th Edition). New York: John Wiley Bhargava, Rajeev & Acharya, Ashok (2008) Political Theory; An Introduction (2nd Edition). Pearson Education India
Development Economics	Misra, S. K. and Puri, V. K. (2005), Development and Planning: Theory and Practices (13th Revised Edition), Himalaya Publishing House, Bombay Todaro, M. (2000) Economic Development.7th Ed. Delhi: Pearson Education. 338.9 TOD.SMI Thirlwall, A. P. (2006) Growth and Development with Special Reference to Developing Economies. 8th ed. Hampshire: Palgrave Macmillan. 338.90091724 THI/Gro Meier, G. M. & Rauch, J. E. (2000) Leading Issues in Economic Development.7thed. New York: OUP. 338.9 MEI.RAU Ray, D. (1998) Economic Development. New Delhi: OUP 338.9 RAY/DEV
Introduction to Development Studies	Rapley, John. 2009. Understanding Development: Theory and Practice in the Third World (3rdEdition).Viva Books
International Relations	John Baylis;(2001). The Globalization of World Politics: An Introduction to International Relation; Oxford University Press; 2nd Edition. http://bit.ly/XhmCPF https://yfadukypyz.files.wordpress.com/.../the-globalization-of-world-pol... https://peaceandconflictstudiesblog.files.wordpress.com/.../the-globalizati... Students are also expected to be familiar with NCERTs Contemporary World Politics - http://www.ncert.nic.in/ncerts/textbook/textbook.htm?leps1=0-9
Ecocriticism	Garrard, Greg. Ecocriticism. London: Routledge, 2012. Print. Cheryll Glotfelty and Harold Fromm. Eds. The Ecocriticism Reader: Landmarks in Literary Ecology. Athens: University of Georgia Press, 1996. Print.
Science and Technology Studies	Felt, U., Fouche, R., Miler, C.A. & Smith-Doer, L. (Eds.) (2017) The Hand Book of Science and Technology Studies (Fourth Edition): MIT Press.

9. Management

Subject	Content	Reference Books
Marketing	Developing Marketing Strategies and Plans, Marketing Research, Creating customer value and customer relationships, Analyzing consumer markets, Analyzing Business Markets, Identifying Market Segments and Targets, Competitive Dynamics, Crafting the Brand position, Creating Brand Equity, Setting Product strategy, Designing and managing services, Developing Pricing strategies and Programs, Designing and Managing Integrated Marketing Channels, Designing and Managing Integrated Marketing Communications	Kotler Philip, Kevin Lane Keller, Abraham Koshy, Mithileswar Jha; "Marketing Management – A South Asian Perspective", Pearson Education India Limited, New Delhi, 14 th Ed., 2013. Malhotra Naresh K. and Dash Satyabhushan, Marketing Research: An Applied Orientation. Pearson Education, 2015, 7th Edition.
Production & Operations Management	Forecasting, Facility Location Planning, Facility Layout Planning, Aggregate Planning, Inventory Management, Statistical Process Control, Production scheduling, Materials Requirement Planning, Just in time and Lean Operations	Heizer, J.; Render, B. and Rajashekhar, J., Operations Management, Pearson Education, India, 9th Edition, 2009.
Finance & Accounting	Concepts and Relevance of Accounting Information in the Business, Golden Rules of Accounting, Journal Entries, Ledger and Trial Balance, Preparation of Financial Statement – Trading, Profit and Loss A/C, Balance Sheet, Cash flow statement. Analysis of Financial Statements – Ratio Analysis	Anthony Robert N., Hawkins David F., Merchant Kenneth A., Accounting: Text and cases, 12th edition-2007, Tata McGraw Hill
HR & OB	Personnel Planning and Recruitment, Selection, Testing and Interviews, Training and Development, Performance Management and Appraisal, Employee Retention, Engagement and Careers Compensation, Benefits and Services, Ethics, Employee Safety and Health, Labour Relations and Collective Bargaining, Personality, Motivation, Perception, Organizational Culture, Group behavior and leadership	Dessler Gary, Varkkey Biju (2015), Human Resource Management, 14th edition. Pearson Education Stephen P. Robbins, Organizational Behavior, 15th edition. Pearson Education

10. Mathematics

Subject	Content	Reference Books
Algebra	Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in congruences, Chinese Remainder Theorem, Euler - function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley‟s theorem, class equation, Sylow's theorem. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.	Topics in Algebra by I.N. Herstein, Vikas Publishing House Pvt Ltd.
Analysis	Elementary set theory, finite, countable and uncountable sets, real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Reimann sums and Reimann integral, improper integrals and Reimann Stieltjes integral. Monotonic functions, types of discontinuity, functions of bounded variation. Lebesgue measure, measurable sets, measurable functions, Riemann and Lebesgue integral and their properties. Differentiations, functions of bounded variations, spaces, different modes of convergence, metric spaces, compactness, connectedness. Normed linear spaces, spaces of continuous functions as examples	Principle of Mathematical Analysis by W. Rudin, Mc- graw hill Publishers. Measure Theory and Integration by G. D. Barra, Willey Eastern.
Topology	Topological spaces; special topologies, subspaces, product spaces and quotient spaces, continuity and homeomorphisms, connectedness and compactness, fundamental groups of surfaces	Topology by J.R. Munkres, Pearson Education publication. Introduction to Topology and Modern Analysis by G.F. Simmons, Mc-graw hill Publishers.
Ordinary Differential Equations (ODEs)	Existence and uniqueness of solutions of initial value problems for first order ODEs, singular solutions of first order ODEs, system of first order ODEs. General theory of homogeneous and non-homogeneous linear ODEs, variation of parameters, Strum-Liouville boundary value problems, Green‟s function.	Differential Equations by G.F. Simmons. Elementary Differential Equations and Boundary Value Problems, 8th Edition, with ODE Architect CD by G. Krantz, Wiley.
Partial Differential Equations (PDEs)	Lagrange and Charpit's methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, general solution of higher order PDEs with constant coefficients, method of separation of variables for Laplace, Heat and Wave equations	Elements of Partial Differential Equations by I.N. Sneddon, Mc-graw hill Publisher.

Linear Algebra	Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley- Hamilton‟s theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.	Linear Algebra by K. Hoffmenn and R. Kunze, Prentice hall of India Pvt Ltd. Linear algebra and matrix theory by J. Gilbert and L. Gilbert, Brooks Cole. Introduction to linear algebra by G. Strang Wellesley Cabridge Press.
Complex Analysis	Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy‟s theorem, Cauchy‟s integral formula, Liouville‟s theorem, maximum modulus principle, Schwarz lemma, open mapping theorem. Taylor's series, Laurent's series, calculus of residues. Conformal mappings, Mobius transformations.	Complex Variables and Applications by James Brown, R. V Churchill.
Numerical Analysis	Computer arithmetic and errors, numerical solutions of algebraic equations, method of iteration and Newton- Raphson method, rate of convergence. Solution of systems of linear algebraic equations by using Gauss elimination and Gauss-Seidel methods. Finite differences, Lagrange, Hermite and spline interpolation, numerical differentiation and integration. Numerical solution of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.	Applied Numerical Analysis by Gerald and Wheatley 6/E, Pearson Education.
Probability	Sample space, discrete probability, independent events, Bayes‟ theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebycheff, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, central limit theorems (i.i.d. case).	Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences by J. Susan Milton. Schaum‟s Outline of Probability and Statistics by Murray R Spiegel, John J. Schiller, R. Alu Srinivasan.
Optimization	Modeling with linear programming, general L.P.solution, The simplex method, duality and post optimal analysis, transportation model and its variants, goal programming and integer linear programming, non linear programming algorithms.	Operations Research: An Introduction by Hamdy A Taha 8/E, Prentice Hall India/Pearson Education.
Operations Research	Queuing systems: Poisson queuing systems, Reliability: reliability and hazard rate function of series and parallel systems, inventory systems: single item inventory models, simulation and game theory, network models and deterministic dynamic programming.	Operations Research: An Introduction by Hamdy A Taha.
Advanced Calculus	Functions of several variables, directional derivative, partial derivative, and derivative as a linear transformation, inverse and implicit function theorems.	Thomas‟s Calculus (11th Edition) by George B. Thomas, Maurice D. Weir, Joel Hass and Frank R. Giordano, Pearson Publication.

11. Mechanical

Subject	Content	Reference Books
Production Techniques	Metal casting, Metal forming, powder metallurgy, plastic forming and molding, Metal joining, Metrology, metal cutting theory, machining processes, welding processes and Non-conventional manufacturing processes.	Campbell, J.S., Principles of Manufacturing Materials and Processes, 23rd reprint, Tata McGraw Hill, 2006. Ghosh, A. and Malik, A.K., Manufacturing Science, 2nd edition, East-West Press Pvt. Ltd., 2010. Kalpakjain, S. and Schmid, S. R., Manufacturing Engineering and Technology, 5th edition, Pearson Education, 2006.
Materials Science and Engineering	Introduction, Structure of Materials (Metal and Ceramics), Dislocations, heat treatment of steel and strengthening Mechanisms of Metals, Phase diagrams, Iron-carbide phase diagram, Phase transformation in Metals, Mechanical and thermal properties of Metals, Polymers (Structure, processes and properties) and introduction to non-destructive testing.	William D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction, NinthEdition, Wiley, 2013. V. Raghavan, Material science and engineering, 6th Edition, Prentice-Hall of India private Limited, 2015.
Production Planning and Control	Forecasting and product planning, Process planning, job design and work measurements, Facilities location and layout, Capacity planning, aggregate planning and scheduling, Inventory and quality control.	Gaither, N. and Frazier, G., Operations Management, 9th Edition, Thomson South Western, 2007 Reprint.
Design of Machine Elements	Criteria for static failure and fatigue failure, design of screws and bolted joints, design of welded joints and riveted joints, Mechanical springs, Design of rolling element bearings, journal bearings and hydrodynamic lubrication, Design of gears, clutches, brakes, couplings, flat and V-belt drives, Computeraided design, and geometric modeling of mechanical parts.	Shigley, J. E. and Mischke, C. R., Mechanical Engineering Design, 9th edition, Tata McGraw-Hill, 2001.Zeid, I., CAD/CAM: Theory and Practice, Tata McGraw-Hill, 1991.
Kinematics & Dynamics of Machines and Vibrations	Basics of mechanisms, inversions, Velocity and acceleration analysis, Instantaneous centres, transmission angle, Principle of virtual work, D'Alembert's principle, Kinetic Modeling, kinetics of mechanism (Four-bar mechanisms) and synthesis of cam – follower motion, Flywheels, governors, gyroscope and balancing, Free and forced vibration, Multi-degree of freedom (two dof) free and forced vibrations, mode shapes, approximate methods of solutions.	Uicker J.J., Pennock G.R., Shigley J.E., Theory of Machines and Mechanisms, 3rd edition, Oxford University Press, 2003. Thomson W T, Dahleh M D & Padmanabhan C, Theory of Vibrations with applications, 5th Edition, Pearson,2015.
Mechanics of Solids	Fundamental principle of mechanics, Introduction to mechanics of deformable bodies, slender members, energy Methods, Stress and strain: stress-strain-temperature relations, Symmetric and asymmetric bending, torsion, Curved beams and thick shells, Buckling.	Crandall, S. H., Dahl, N. C. and Langner, T. J., An Introduction to Mechanics of Solids, McGraw Hill, 1984. Boresi, A. and Schimid, R., Advanced Mechanics of Materials, John Wiley & Sons.
Thermodynamics	Properties of pure substance, First law of thermodynamics, Second law of thermodynamics, Entropy, Irreversibility, energy and thermodynamic relations.	Sonntag, R. E., Borgnakke, C. and Van Wylen, G. J. Fundamentals of Thermodynamics, 7th edition, John, Wiley & Sons (Asia) Pte. Limited, 2009. A. Cengel, Michael A. Boles, Thermodynamics an Engineering Approach, 7th edition, Mcgraw Hill Education, 2011.

Applied Thermodynamics	Air standard cycles, gas power cycles, I.C. engines, Vapour compression and absorption cycle, Psychometrics and air conditioning, Vapour power cycles, boilers, its mountings and accessories, steam turbines, gas turbines, compressors.	Nag P.K., Basic and Applied Thermodynamics, 3rd edition, Tata McGraw Hill, 2002.Nag P.K., Power Plant Engineering, 2nd edition, Tata McGraw Hill, 2001. T.D. Eastop, A. Mcconkey, Applied Thermodynamics for Engineering Technologists, Pearson Education, 2009.
Fluid Mechanics and Machines	Fluid statics, Conservation laws, Viscous and inviscid flow analysis, Dimensional analysis, Analysis of fluid machines.	Frank White, Fluid Mechanics, 8th edition, McGraw Hill Education, 2016 Fox, Mcdonald, Pritchard, Fluid Mechanics, 8th edition, John Wiley & Sons, 2011
Heat Transfer	Conduction: steady state and unsteady state heat conduction, Convection: analytical and empirical relations for forced and free convection heat transfer, condensation and boiling, Radiation heat transfer: basic laws, shape factor, radiation heat exchange between surfaces, Heat exchanger: analysis and design, Mass transfer: diffusion and convective mass transfer.	Holman, J. P., Heat Transfer, McGraw Hill, 9th Edition, 2002. T. Bergman, A. S. Lavine, F. P. Incropera, D. P. DeWitt, Fundamentals of Heat and Mass Transfer, 7th Edition, John Wiley & Sons, 2011

12. Physics

Subject	Content	Reference Books
Modern Physics	Special Theory of Relativity, Particle-like Properties of Waves, Wave-like Properties of Particles, Heisenberg Uncertainty Relation, Bohrs Model of Hydrogen-like Atoms, Schrodinger Equation, Particle in One-dimensional Potential, Particle in One-dimensional Potential, Many Electrons Atoms, Physics of Molecules, Nuclear Transformations	R. Eisberg & R. Resnick, Quantum Physics of Atoms, Molecules & Solids, WSE, 2nd ed., 1985 Arthur Beiser, Concepts of Modern Physics, Tata McGraw-Hill, 6th ed., 2005
Thermodynamics & Properties of Matter	Thermometry, Thermal Expansion, Heat, Work and the First Law of Thermodynamics, Second Law of Thermodynamics, Heat Engines and Entropy, Kinetic Theory, Phase Transformations, General Properties of Matter	Zemansky & Dittman, Heat & Thermodynamics, 6th ed., McGraw-Hill, 1981
Classical Mechanics	Constraints, Generalized Coordinates, De- Alemberts principle, Lagranges Equations of Motion, Two-body Central force motion, Rigid Body Kinematics, Rigid Body Dynamics, Hamiltons Equations of Motion	H Goldstein, Classical Mechanics, Pearson Education, 3rd ed., 2002
Electromagnetic Theory	Electrostatics in Free Space, Electrostatics in Matter, Magnetostatics in Free Space, Magnetostatics in Matter, Faraday"s Law of Electromagnetic Induction, Maxwells Equations, Conservation Laws, Electromagnetic Waves, Electromagnetic Potentials, Fields and Radiations	D. J. Griffiths, Introduction to Electrodynamics, Pearson Education, 3rd ed., 1999
Quantum Mechanics	Schrodinger Equation, Eigenvalues, Eigenfunctions, Eigenfunction Expansion, Dirac Notation, Operator Methods, Harmonic Oscillator, Angular Momentum, Central Force Problem, The Hydrogen Atom, Spin, Identical Particles, Time Independent Perturbation Theory	Richard L. Liboff, Introductory Quantum Mechanics, Pearson Education, 4th ed., 2003 Stephen Gisiorowicz, Quantum Physics, John Wiley & Sons Inc., 3rd ed., 2003
Methods of Mathematical Physics	Vector Analysis, Curvilinear Coordinates, Matrices and Vector Spaces, Functions of Complex Variables, Ordinary Differential Equations, Sturm-Lioville Theory and Special Functions, Elements of Partial Differential Equations	Mathew Jon & R. Walker, Mathematical Methods of Physics, Pearson Education, 2nd ed., 1970 Arfken & Weber, Mathematical Methods for Physicists, Academic Press, 6th ed., 2005
Statistical Physics	Elements of Probability Theory, Elementary Kinetic Theory, Microcanonical, Canonical & Grand Canonical Ensembles and Their Applications, Quantum Statistics of Ideal Bose Gases, Quantum Statistics of Ideal Fermi Gases	Pathria R K, Statistical Mechanics, Elsevier, 2nd ed., 1996
Solid State Physics	X-ray Diffraction and Crystal Structure, Lattice Dynamics, Free Electron Theory of Metal, Electron in Periodic potential, Energy Bands, Semiconductors, Superconductivity	Kittel C., Introduction to Solid State Physics, WSE, 7th ed., 1995
Optics & Spectroscopy	Geometrical Optics, Interference, Diffraction, Polarization, Crystal Optics & Lasers, Atomic & Molecular Spectroscopy	Ghatak, A K, Optics, Tata McGraw-Hill, 3rd ed., 2005 Banwell C N, Fundamentals of Molecular Spectroscopy, Tata Mc- Graw-Hill, 4th ed., 1994
Nuclear & Particle Physics	Nuclear Properties and Nuclear Models, Fission & Fusion, The Quark Model, Elementary Particles, their Classification and Interactions, Particle Accelerators, Conservation Laws of Elementary Particles and Fundamental Interactions	Krane K, Introductory Nuclear Physics, John Wiley & Sons, 1st ed., 1988 Griffiths, D J, Introduction to Elementary Particles, WIE, 1st ed., 1987

13. Nanoscience & Nanotechnology

Subject	Content	Reference Books
Fundamental of Materials (structure and properties)	Structures of materials: Metals, ceramics and polymers; Crystallographic directions and planes, Linear and planner densities, close-packed crystal structures, defects, dislocations, & diffusions. Polymers and composites, semiconducting materials; self-assembled monolayer, Phase transformations & phase diagrams: Basic thermodynamics & kinetics of nucleation and growth. Correlation of structure to properties: mechanical, chemical, electrical, magnetic and optical. Evolution of materials: functional materials, Biomimetic materials, energy saving materials, etc Criteria for material selection	Callister's Materials Sc & Engg, W.D. Callister & R. Balasubramaniam (Adapted), Wiley, 2nd. ed., 2014. Materials science and engineering by V. Raghavan, 5th edition, Prentice Hall of India, ISBN: 978-81-203-2455-8 Nano: The Essentials, Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, First edition, 2007. ISBN 10 0070617880, ISBN 13 9780070617889
Synthesis of Nanomaterials	Bottom up methods: chemical reduction, solvothermal synthesis, photochemical, electrochemical, sonochemical, thermolysis, biological methods etc. Top down methods: Lithography, Electron beam lithography, Ion beam lithography, X-ray lithography, UV lithography, Synthesis of nanomaterials by Laser ablation etc. Chemical Vapor Deposition (CVD) Nanopolymer, carbon based nanostructures - carbon nanotube, graphene, fullerenes. Anisotropic metal nanoparticles, nanowires, quantum dots, nanoclusters, 2D nanostructure array, 3D Superlattice, Bimetallic nanoparticles. Self-assembled monolayer	Fundamentals of Nanoscience, S L Kakani & Shubhra Kakani, New Age International Publishers, 1st Edition, 2017, ISBN: 9789386286505 Nanostructures and Nanomaterials; Synthesis, Properties, and Applications. Guozhong Cao and Ying Wang, World Scientific Series in Nanoscience and Nanotechnology, 2nd edition, 2011, Nanomaterials Synthesis Design, Fabrication, and Applications, Yasir Beeran Pottathara et al, Elsevier, 1st edition, 2019, ISBN 978-0-12-815751-0
Characterization of Nanomaterials	Diffraction Methods : XRD Microscopic Analysis: Principles and operational aspects of SEM, TEM, AFM, STM Spectroscopic Analysis: Principles and operational aspects of UV-Vis, FTIR, Raman, X-ray photoelectron spectroscopy (XPS), Photoelectron spectroscopy (PES) Adsorption Based Techniques: Physisorption (surface area, porosity, and textural analysis) and chemicsorption (TPR, TPO, TPD, pulse-chemisorption, etc.) study	
Application of Nanotechnology	Use of nanomaterials in the • catalysis, • medical, • food and agriculture industries, • automobile, • textile, • water-treatment, • nano-electronic devices, • biological, • MEMS, NEMS and sensors, • strategic use in energy, space and defense.	Nanomaterials Synthesis Design, Fabrication, and Applications, Yasir Beeran Pottathara et al, Elsevier, 1st edition, 2019, ISBN 978-0-12-815751-0. Introduction to Nanoscience and Nanotechnology, An Indian Adaptation, Charles P. Poole; Jr.; Frank J. Owens, Wiley India Pvt Ltd., ISBN-10 : 9354240208, ISBN-13 : 978-9354240201