

**RIMT UNIVERSITY**  
**MANDI GOBINDGARH, PUNJAB**



**RIMT**  
**UNIVERSITY**

**Study Scheme & Syllabus**

**For**

**Ph.D. (2020 Onwards)**  
**(ENGINEERING & TECHNOLOGY)**

**RIMT UNIVERSITY**  
**MANDI GOBINDGARH, PUNJAB**

**VISION**

To become one of the most preferred learning places and a centre of excellence to promote and nurture future leaders who would facilitate the desired change in the society.

**MISSION**

- To impart teaching and learning through cutting-edge technologies supported by the world class infrastructure
- To empower and transform young minds into capable leaders and responsible citizens of India instilled with high ethical and moral values.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

**ABOUT THE PROGRAM**

The program will develop the candidate's independent and reflective knowledge and skills for his/her own research and others as well as the role of research in a broader context. A candidate will achieve the following course outcomes in terms of knowledge, skills, and general competencies, after completing the Ph.D. program.

## PROGRAM EDUCATION OBJECTIVES

PEO1	To acquaint students with the concept of research and to develop an understanding of the nature and scope of research in respect.
PEO2	Students will be equipped with skills to undertake research work
PEO3	To develop an understanding of the basic framework of the research process and publications
PEO4	To develop the capacity to serve the various higher academic institutions like Colleges, Universities, and National Research Institutes in various fields of apex academic research

## Program Outcomes for Ph.D.

<b>PO 1</b>	Understanding different research methods, Equipping scholars with relevant tools and techniques, Data collection and analysis by using statistical measures, use of conceptual understanding in practical research work, and writing a research report.
<b>PO 2</b>	To identify and critically evaluate research and publication of ethical issues within the area of teacher education
<b>PO 3</b>	Enhance the analytical and interpretation skills of data, Scholars are well trained in using statistical measures, and software- SPSS; MS EXCEL, etc.
<b>PO 4</b>	Use ICT in research perspective, design and develop ICT integrated learning resources, analysis, and interpretation of the research data with the help of ICT.
<b>PO 5</b>	Apply critical, analytical, and communication skills in developing professional presentations and writing.
<b>PO 6</b>	To access and extract the desired information from the different scientific databases and resources
<b>PO 7</b>	Develop the analytical and reflective skills for resolving the critical educational issues
<b>PO 8</b>	Students will be acquainted with the statistical techniques in research

## PROGRAM SPECIFIC OUTCOMES

<b>PSO 1</b>	To bring together theory and research from engineering and other related disciplines to facilitate effective designing & Implementation.
<b>PSO 2</b>	To develop an understanding and appreciation for the various kinds of research as well as their aspects.
<b>PSO 3</b>	To disseminate engineering & technology research at recognized national and international level

**Program: Ph.D. Course Work**

**Program Code: 501**

Subject Code	Subject Name	(Hours Per Week)				
		L	T	P	S	Credits
<b>RMS 5011</b>	Research Methodology & Statistical Techniques	<b>5</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>5</b>
<b>CAR 502M</b>	Computer Applications in Research	<b>3</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>3</b>
<b>XXX 5 0XX</b>	Core Subject	<b>5</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>5</b>
<b>RPE 503 M</b>	Research Publications & Ethics	<b>2</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>2</b>
<b>MRP 504 M</b>	Research Project/ Literature Review	<b>2</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>2</b>
		<b>17</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>17</b>

## RIMT UNIVERSITY

**Course Name: Research Methodology & Statistical Techniques**

**Course Code: RMS 5011**

### Course Objectives

- a) To familiarize participants with the basics of research and the research process.
- b) To enable the participants in conducting research work and formulating a research synopsis and report.
- c) To impart knowledge for enabling students to develop data analytics skills and meaningful interpretation of the data sets to solve the business/Research problem.

### Unit-I

**Introduction to Research Methodology:** Meaning, nature, and scope; types of research, and research process. *Problem Definition:* Research problem; the necessity of defining the problem; techniques involved in defining a problem; review of literature and identification of research gaps.

**Research Design:** Meaning of research design; need for research design; features of a good design; important concepts relating to research design; and different research designs.

**Sampling Design:** Census and sample survey; steps in sampling design; criteria of selecting a sampling; characteristics of a good sample design; different types of sample designs; and random sampling design.

### Unit-II

**Measurement and Scaling Techniques:** Sources of error in measurement; tests of sound measurement; and important scaling techniques.

**Data Collection:** Collection of primary data; observation method; interview method; a collection of data through questionnaires; collection of data through schedules; latest advances in methods of data collection; collection of secondary data; the case study method.

**Data Analysis-I:** *Descriptive Statistics Analysis* covering measures of central tendency, dispersion and asymmetry; measures of relationship using regression, correlation, and association (in case of attributes). *Inference Statistics Analysis* covering sampling theory, concept of standard error, and the problem of estimation of a sample size.

### Unit-III

**Data Analysis-II:** Testing of hypotheses covering basic concepts, procedure for hypothesis testing, tests of hypotheses, tests of significance for large samples and small samples, students t-distribution, properties, and t-distributions and the t-levels applications of the t-distribution, chi-square test and goodness of fit, F-test and Z test, analysis of variance, non-parametric test, The Mann – Whitney test, Krushal-Wallias test.

*Multivariate Regression Analysis*: econometric model formulation, estimation, testing and interpretation.

#### Unit-IV

**Research Tools:** *MS-Excel*, covering broad structure, features, data /file handling, formulae /functions and brief review of utilities of the package. *Statistical/Econometric Package* covering structure of package, data and file handling utilities and analysis utilities of the package.

**Interpretation and Report Writing:** Technique of Interpretation: Different Steps in Writing Report.

**Course Outcomes:** On completion of this course, the student will be:

CO1	Develop an understanding about various kinds of research, objectives of doing research, research process, research design, and sampling.
CO2	Have a basic knowledge of qualitative research techniques.
CO3	Acquire an adequate knowledge of measurement and scaling techniques as well as the quantitative data analysis.
CO4	Get a basic awareness of data analysis and hypothesis testing procedures.

#### Recommended books:

1. Kothari, C.R., *Research Methodology: Methods and Techniques*, New Age International Publishers, New Delhi, 2010.
2. Garrett Henery E., *Statistics in Psychology and Education*, Longmans, Green, And Co., 1958.
3. Fisher, R.A., *Statistical Methods for Research Workers*, Springer-Verlag New York, Inc. 1992.
4. Gupta, S.P, *Statistical Methods*, Sultan Chand & Sons, New Delhi, 2019.
5. Allen, R.G.D., *Statistics for Economists*. London (Hutchinson), 1949.
6. Blair, Morris M. *Elementary Statistics*, Henry Holt and Co., 1944
7. Smith and Smith, *Business and Economic Statistics*, South Western publishing co., 1996.

**Ph.D. Course Work**  
**Course Name: Computer Applications in Research**

**Course Code: CAR 502M**

Sr. No	Contents
<b>Unit I</b>	<b>Computer Fundamentals:</b> Data and Information, Characteristics of Computers, Various fields of application of Computers, Input-output Devices (Hardware, Software, Human ware and Firmware), Advantages and Limitations of Computer, Block Diagram of Computer, Function of Different Units of Computer, Classification of Computers. Types of Software, Application software and system software. Introduction to Operating System.
<b>Unit II</b>	<b>Word Processor:</b> Various aids useful for thesis writing, adding references to documents, citing a citation in text, macros, hyperlinks, mail-merge etc. <b>Power Point Presentations:</b> PowerPoint, Features of MS PowerPoint Clipping, Design layouts, hyperlinks, tables, insertion of multi-media files, Slide Animation, Slide Shows, Formatting etc. Case study. <b>MS-Excel:</b> Introduction to Electronic Spreadsheets, Feature of MS-Excel, Entering Data, Entering Series, Editing Data, Cell Referencing, ranges, Formulae, Functions, Auto Sum, Copying Formula, Formatting Data, Creating Charts, Statistical functions, Sorting Data, Filtering etc.
<b>Unit III</b>	<b>Internet and applications of IT:</b> Program Vs Software, Software Engineering, SDLC, DBMS, Data Models, DFD, Specification Tool: SMARTDRAW. Case Study on DFD.
<b>Unit IV</b>	<b>Latest trends in Computing:</b> Cloud computing, Data mining, Data Warehousing, Object Oriented Relational Database Management, Object Oriented Relational Database Management System, Distributed databases Concept, Three tier Client/ Server Architecture, Digital Image Processing, etc.

**Course Outcomes:** On completion of this course, the student will be:

<b>CO1</b>	Present the graphical representations of data
<b>CO2</b>	Make use of applications of MS Office
<b>CO3</b>	Learn the functional units and classify types of computers, how they process information and how individual computers interact with other computing systems and devices

**Recommended books:**

1. Pardeep K. Sinha, Priti Sinha, Computer Fundamentals, BPB Publications.
2. Rajaraman, V., Fundamental of Computers. Prentice Hall India, New Delhi.
3. R. S. Salaria, Fundamentals of Computers, Salaria Publishing House

**Ph.D. Course Work**  
**Course Name: Research Publications & Ethics**

**Course Code: RPE 503M**

**THEORY:**

- **RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**
  1. Introduction to philosophy: definition, nature and scope, concept, branches
  2. Ethics: definition, moral philosophy, nature of moral judgments and reactions
  
- **RPE 02: SCIENTIFIC CONDUCT (5 hrs.)**
  1. Ethics with respect to Science and Research
  2. Intellectual honesty and research integrity
  3. Scientific Misconducts: Falsification, Fabrication and Plagiarism (FFP)
  4. Redundant publications: duplicate and overlapping publications, salami slicing
  5. Selective reporting and misrepresentation of data
  
- **RPE 03: PUBLICATION ETHICS (7 hrs.)**
  1. Publication ethics: definition, introduction and importance
  2. Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.
  3. Conflicts of interest
  4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
  5. Violation of publication ethics, authorship and contributorship
  6. Identification of publication misconduct, complaints and appeals
  7. Predatory publishers and journals

**PRACTICE:**

- **RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)**
  1. Open access publications and initiatives
  2. SHERPA/ ROMEO online resource to check publisher copyright & self-archiving policies
  3. Software tool to identify predatory publications developed by SPPU



4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

- **RPE 05: PUBLICATION MISCONDUCT (4 hrs.)**

- A. Group Discussions (2 hrs.)
  1. Subject specific ethical issues, FFP, authorship
  2. Conflicts of interest
  3. Complaints and appeals: examples and fraud from India and abroad
- B. Software tools (2 hrs.)
 

Use of plagiarism software like Turnitin, Urkund and other open source software tools

- **RPE 06: DATA BASES AND RESEARCH METRICS (7 hrs.)**

- A. Databases (4 hrs.)
  1. Indexing databases
  2. Citation databases: Web of Science, Scopus, etc.
- B. Research Metrics (3 hrs.)
  1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
  2. Metrics: h-index, g-index, i10index, altmetrics

**Course Outcomes:** On completion of this course, the student will be:

<b>CO1</b>	To identify research misconduct and predatory publications.
<b>CO2</b>	To understand the philosophy of science and ethics, research integrity and publication ethics
<b>CO3</b>	To identify research misconduct and predatory publications. To understand the usage of plagiarism tools.
<b>CO4</b>	To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.)

**SUGGESTED READINGS:**

- The Ethics of Teaching and Scientific Research By Miro Todorovich; Paul Kurtz; Sidney Hook.
- Research Ethics: A Psychological Approach By Barbara H. Stanley; Joan E. Sieber; Gary B. Melton
- Research Methods in Applied Settings: An Integrated Approach to Design and

Analysis By Jeffrey A. Gliner; George A. Morgan Lawrence Erlbaum Associates, 2000

- Ethics and Values in Industrial-Organizational Psychology By Joel Lefkowitz Lawrence Erlbaum Associates, 2003.
- Robin Levin Penslar, Research Ethics: Cases and Materials, Indiana University Press
- Chowdhary, N., & Hussain, S. (2021). Handbook of Research and Publication Ethics. Bharti Publications: New Delhi

**Ph.D. Course Work**  
**Course Name: Research Project/ Term Paper**  
**Course Code: MRP 504 M**

Each student enrolled for Ph.D. will have to undertake atleast two credit of Research Project/ Term Paper. The topic of the Research Project/ Term Paper will be given by the committee of faculty of the department with the approval of Head of the department. Student will make presentation on the assigned topic in front of all the faculty members and following criteria will be used to assess the performance of the students:

**Criteria for assessment of Essay:**

The faculty members of the department will evaluate the presentation of the students using the following criteria:

	Definition and Methodology	Literature review/ Conceptual Framework	Findings and Conclusion	Presentation and Communication of Ideas	Questions-answers	Report File
Marks	15	15	15	15	15	25

Averages of all the marks awarded by the faculty members will be utilized to final assess the performance of students.

# CORE COURSES

### Offered Core Subjects

<b>Core Stream</b>	<b>Subject Name</b>	<b>Subject Code</b>
Mechanical Engineering	Advanced Manufacturing Processes	MEE5 031
Mechanical Engineering	Operations Management	MEE5 032
Mechanical Engineering	Advanced Materials Technology	MEE5 033
Electronics & Communications Engineering	Information Theory & Coding	ECE 5 031
Electronics & Communications Engineering	Optical Communication Systems	ECE 5 032
Electronics & Communications Engineering	Advanced Communication Systems	ECE 5 033
Civil Engineering	Industrial And Hazardous Waste Management	CIV 5 031
Civil Engineering	Construction Maintenance & Management	CIV 5 032
Civil Engineering	Composite Materials	CIV 5 035
Civil Engineering	Remote Sensing & GIS	CIV 5 037
Civil Engineering	Advanced Foundation Engineering	CIV 5 038

<b>Core Stream</b>	<b>Subject Name</b>	<b>Subject Code</b>
Computer Science & Engineering	Latest Trends in Computer Science & Engineering (Core Subject)	CSE 503 M

## Detailed Syllabus

**Subject Code: MEE5 031**

**Subject Name: ADVANCED MANUFACTURING PROCESSES**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

**Course Objectives:** To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design. To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications. To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.

<b>CO1</b>	Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
<b>CO2</b>	Select the best process out of the available various advanced manufacturing processes for the given job assignment.
<b>CO3</b>	Solve the various problems for the given profiles to be imparted on the work specimens.
<b>CO4</b>	Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.

<b>S. No.</b>	<b>Content</b>
<b>Unit I</b>	<b>Mechanical Processes:</b> Development and classification, Considerations in process selection, Tool design, Mechanism of material removal in: Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Magnetic abrasive finishing, Parametric analysis: Effect of process parameters on material removal rate, surface finish, Process capabilities, Engineering applications, Development of Hybrid processes.
<b>Unit II</b>	<b>Thermal Metal Removal Processes:</b> Historical background and classification, Characteristics of process, Mechanism of material removal in: Electric discharge, Wire electric discharge, laser beam, Plasma arc, Electron beam advanced machining processes, Parametric analysis, advantages and limitations, applications
<b>Unit III</b>	<b>Electrochemical Machining and other Processes:</b> Introduction, Mechanics, Tool design, Electrochemistry of ECM process, Kinematics and Dynamics, Effect of heat and H <sub>2</sub> bubble generation, Calculation of material removal rate, Parametric analysis, advantages and limitations, applications, Microwave processing, Explosive forming: Principle, Process parameters, Equipment, Mechanics and applications.

**Recommended Books:**

1. Pandey, P.C. and Shan H.S., Modern Machining Processes, Tata McGraw Hill (2004).
2. Mishra, P.K., Non Conventional Machining, Narosa Publications (2006).
3. Hofy, H.E., Advanced Manufacturing Process, B and H Publication (1998).
4. Jain, V.K., Advanced Machining processes, Allied Publishers Private Limited (2004).
5. Ghosh, A. and Mullik, A., Manufacturing Science, East –West private Limited (2010).



## Detailed Syllabus

**Subject Code: MEE5 032**

**Subject Name: OPERATIONS MANAGEMENT**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

**Course Objectives:** The objective of this course is to develop understanding of the strategic role of operations management in creating and enhancing a firm's competitive advantages. This will help to apply key concepts and issues of OM in both manufacturing and service organizations. Further, apply analytical skills and problem-solving tools to the analysis of the operations problems like forecast demand, material requirement planning, inventory etc.

<b>CO1</b>	Understand the fundamental theory of operations and production management.
<b>CO2</b>	Solve various kinds of problems or issue faced by service and manufacturing industries like economic consideration, optimum utilization of resources, productivity solve various kinds of problems or issue faced by service and manufacturing industries
<b>CO3</b>	Solve various kinds of problems or issue faced by service and manufacturing industries for production planning, inventory management and control.
<b>CO4</b>	Get the solutions for materials requirement planning

<b>S. No.</b>	<b>Content</b>
<b>Unit I</b>	<b>Production Systems:</b> Production/ Operations Management: meaning and scope; significance of operations management in increasing productivity of firms; design of different production systems (project, job shop, batch.
<b>Unit II</b>	<b>Forecasting Analysis:</b> Need, benefits and applications, cost and accuracy of forecasting, factors affecting demand, types of forecast based on methodology, types of forecast based on time horizon (causal methods, time series and qualitative methods); error analysis in quantitative forecasting.
<b>Unit III</b>	<b>Aggregate Planning:</b> Need of aggregate production planning, inputs for aggregate plan, Reactive aggregate planning strategies, Aggressive aggregate planning strategies, pure and mixed aggregate planning strategies, level and chase strategies, Graphical method to choose aggregate plan.
<b>Unit IV</b>	<b>Master Production Scheduling and MRP:</b> Functions, planning horizon and planning periods for master production schedule, types of master production schedule; Independent Demand versus dependent demand, Functions of material requirements planning and manufacturing resource planning (MRP I and MRP II), inputs for MRP system, performance characteristics of MRP system (planning lead time, lot sizing rules, safety stocks), materials requirement planning explosion
<b>Unit V</b>	<b>Inventory Management and Control:</b> Objectives and functions of materials management, inventory: need and types, inventory record systems, inventory costs and order quantities, economic order quantity, economic run length.

**Recommended Books:**

1. Monks, J. G., Operations Management: Theory and Problems, McGraw Hill, New York (1987).
2. Krajewski, L. J., Ritzman, L. P. and Malhotra, M. K., Operations Management, Prentice Hall, New Delhi (2009).
3. Ebert, J and Adams, D.J., Production/Operations Management, Prentice Hall of India, New Delhi (2007).
4. Chase, R. B., Aquilano, N. J. and Jacob, F. R., Production and Operations Management: manufacturing and services, Tata McGraw Hill, New Delhi (1999).

## Detailed Syllabus

**Subject Code: MEE5 033**

**Subject Name: ADVANCED MATERIALS TECHNOLOGY**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

**Course Objectives:** To understand the various strengthening mechanisms and also failure mechanisms for alloy systems to achieve enhanced mechanical performance. To gain knowledge with regards to kinetics of phase transformations and their effect on mechanical properties of alloys. To gain knowledge about the characteristics, processing and applications of polymers and composite materials.

<b>CO1</b>	Select suitable welding processes for joining different materials
<b>CO2</b>	Analyze metal removal mechanism in subtractive processes
<b>CO3</b>	Analyze and select appropriate transformation process to develop composites
<b>CO4</b>	Select a hybrid processor coating technology to improve the quality of products

<b>S.No.</b>	<b>Content</b>
<b>Unit I</b>	<b>Strengthening Mechanisms for Alloys:</b> Strengthening by grain refinement, effect of grain size on various mechanical properties, solid solution strengthening, strain hardening, precipitation hardening mechanisms for alloys, especially steels and aluminium.
<b>Unit II</b>	<b>Failure Mechanisms:</b> Ductile and brittle fracture, principles of fracture mechanics, impact fracture testing, design for fatigue, stages of fatigue failure, factors affecting fatigue life, generalized creep behaviour.
<b>Unit III</b>	<b>Phase Transformations in Steels:</b> Kinetics of Phase Transformations, mechanisms of phase transformations, isothermal transformation diagrams, continuous cooling transformation diagrams, influence of alloying elements on these diagrams, heat treatment and surface hardening of steels (plain carbon as well as special purpose steels). Effect of phase transformations on mechanical properties of steels. Hardenability determination in steels. Modeling and simulation tools for analysing phase transformations.
<b>Unit IV</b>	<b>Characteristics, Applications, and Processing of Polymers:</b> Mechanical behaviour of polymers, mechanisms of deformation and for strengthening of polymers, glass transition phenomena in polymers, stress-strain behaviour, fracture of polymers, degradation of polymers.
<b>Unit V</b>	<b>Characteristics, Applications, and Processing of Composites:</b> Classification of composites, factors affecting properties of composites, polymer-matrix composites, metalmatrix composites, processing methods for composites.

<b>Unit VI</b>	<b>Advanced High Strength Steels for Automotive Applications:</b> Dual Phase (DP) steels, Transformation Induced Plasticity steels (TRIP), Complex Phase (CP) steels, Super Martensitic Stainless Steels (SMSS), Super alloys.
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**Recommended Books:**

1. Joachim, R. Harders, S and Baker, M., Mechanical behaviour of engineering materials: metals, ceramics, polymers, and composites, Springer (2007)
2. Parton, V.Z., Fracture mechanics: from theory to practice, CRC Press (1992).
3. Higgins, R. A., Engineering Metallurgy-Applied Physical Metallurgy, Elsevier (2004).
4. Colling, D and Thomas, V., Industrial materials: polymers, ceramics, and composites, Printice-Hall (1995).

**Subject Code: RMS 5 011**

**Subject Name: Research Methodology & Statistical Techniques**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

<b>Sr. No</b>	<b>Contents</b>
<b>Unit I</b>	Research, Meaning, Nature and Scope. Types of Research, Methods of Research, Methodologies of Research, Research Hypothesis, Types of Hypothesis, Formulation of Hypothesis. Parameters and Variables in Research. Research Design. Types of Research Design, Applications of Research Design, sampling Techniques, Sampling Procedures and design. Data Collection, Types of Data.
<b>Unit II</b>	Sampling: Principal, Methods (Probability and Non Probability) Characteristics, Sampling Distribution and Errors, Data Collection Sources (Primary and Secondary) Technique: Observation, Interview, Schedules and Questionnaire.
<b>Unit III</b>	Measures of Central Tendency, Calculation of Arithmetic Mean Median and mode in case of individual discrete and continuous series, merit and demerits, Dispersion, Meaning Significance and types, Calculation of Mean Deviation and Standard Deviation in case of individual, discrete and continuous series. Merit and Demerits of Mean and Standard Deviation Lorenz Curve, Co-efficient of variations (CV)
<b>Unit IV</b>	Correlation Definition, Types, Correlation and Causation, Methods of Correlation, Karl Pearson co-efficient of correlation. Co-efficient of correlation and probable error. Regression analysis, types of regression analysis, difference between correlation and regression, regression lines, regression equations, (Y or X) and (X or Y). Tests of significance for large samples and small samples, students t-distribution, properties, and t-distributions and the t-levels applications of the t-distribution chi-square test and goodness of fit, F-test and Z test, analysis of variance, Non-Parametric test The Mann – Whitney test, Krushal Wallias test, SPSS, uses and its applications. Analysis of Qualitative Data Techniques such as scaling methods.

**Recommended books:**

1. Principles of digital communication: J. Dass. , S.K. Malik & P.K. Chatterjee
2. Introduction to the theory of Error correcting codes: Vera Press
3. Information Theory and Reliable Communication: Robert G. Gallanger Mc Graw Hill
4. Related IEEE/IEE publications

**Subject Code: ECE 5 031**

**Subject Name: Information Theory & Coding**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

<b>Sr. No</b>	<b>Contents</b>
<b>Unit I</b>	<b>Elements of information theory</b> Source coding theorem, Huffman coding, Channel coding theorem, channel capacity theorem, Shenonfano theorem, entropy <b>Sampling Process</b> Base band and band pass sampling theorems reconstruction from samples, Practical aspects of sampling and signal recovery TDM
<b>Unit II</b>	<b>Waveform Coding Techniques</b> PCM Channel noise and error probability DPCM and DM Coding speech at low bit rates Prediction and adaptive filters. Base band shaping for data transmission, PAM signals and their power spectra Nyquist criterion ISI and eye pattern Equalization.
<b>Unit III</b>	<b>Digital Modulation Techniques</b> Binary and M-ary modulation techniques, Coherent and non-coherent detection, Bit Vs symbol error probability and bandwidth efficiency. Bit error analysis, using orthogonal Signaling
<b>Unit IV</b>	<b>Error Control Coding</b> Rationale for coding Linbear block codes, cyclic codes and convolution codes Viterbi decoding algorithm and trellis codes.

**Recommended books:**

1. Principles of digitals communication: J. Dass. , S.K. Malik & P.K. Chatterjee.
2. Introduction to the theory of Error correcting codes: Vera Press.
3. Information Theory and Reliable Communication: Robert G. Gallanger Mc Graw Hill.
4. Related IEEE/IEE publications

**Subject Code: ECE 5 032**

**Subject Name: Optical Communication Systems**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

Sr. No	Contents
<b>Unit I</b>	<b>Introduction to optical fibers</b> Wave propagation Dispersion and its limitations, losses and non-linear effects <b>Optical transmitters</b> LEDs Semiconductor lasers and their characteristics. Transmitter Design
<b>Unit II</b>	<b>Optical receiver</b> Photo detectors and their characteristics. Receiver Design. Noise and Sensitivity in Optical Receivers Sensitivity degradation <b>Optical Amplifiers</b> Semiconductor Optical Amplifier Raman Amplifier. EDFA
<b>Unit III</b>	<b>Dispersion management</b> Need Pre-compensation Schemes Best Compensation Techniques. Dispersion Compensatory Fibers Optical Filters Fiber Bragg Grating
<b>Unit IV</b>	<b>Multichannel Systems</b> WDM Light wave Systems WDM Components System Performance tissues TDM. CDM

**Recommended books:**

1. Fiber-Optic Communication Systems - by GP Aggarwal - John Wiley & Sons
2. Fiber-Optic Communication Systems - by Mynbev - John Wiley & Sons
3. Related IEEE/IEE publications

**Subject Code: ECE 5 033**

**Subject Name: Advanced Communication Systems**

**Time: 3 Hours**

**Max Marks: 100**

**Internal: 40**

**External: 60**

Sr. No	Contents
<b>Unit I</b>	<b>Introduction</b> Introduction to communications systems, analog and digital communication systems, Applications of communication systems. <b>Digital Communication</b> Introduction, Digital Modulation techniques, BPSK, QPSK, PCM, DPCM, Delta Modulation, Digital Transmission and Transmission Impairments.
<b>Unit II</b>	<b>Optical Networks</b> WDM, TDM, Telecommunication Infrastructure, Switching, 3G systems, SONET, SDH, Architecture of Optical Transport Network, Link Management Protocols, Solutions.
<b>Unit III</b>	<b>Satellite Communication</b> Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design Of Down Links, Domestic Satellite Systems Using Small Earth Stations, Uplink Design, Design Of Satellite Link For Specified (C/N). Multiple Access Techniques, Frequency Division Multiple Access (FDMA), TDMA, CDMA, Estimating Channel Requirements, Practical Demand Access Systems, Random Access, Multiple Access With On Board Processing. VSAT
<b>Unit IV</b>	<b>Mobile Communications</b> Mobile telephone service, Transmission protocols, Introduction to GSM, GPRS, CDMA, Switching techniques, Fading, Quality of service (QOS).

**Recommended books:**

1. Advanced Communication Systems - by Wayne Tomasi; Pearson.
2. Digital Communication - by Proakis; PHI
3. Optical Networks - by Uyles Black; Pearson
4. Satellite Communication - by Timothy Pratt; Addison Wesley.



**SUBJECT TITLE: INDUSTRIAL AND HAZARDIOUS WASTE MANAGEMENT****SUBJECT CODE: CIV-5-031****SEMESTER: I****CONTACT HOURS/WEEK:**

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

**Internal Assessment: 40****End Term Exam: 60****Duration of Exam; 3 Hrs****Objective:**

To Understanding and appreciating the environmental pollution and nuisance potential of municipal solid waste and of special category wastes.

**Contents of Syllabus:**

Sr. No	Contents	Contact Hours
<b>SECTION-I</b>	Hazardous Waste Treatment and Disposal: Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes; Land farming; Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.	<b>14</b>
<b>SECTION-II</b>	Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc. Sources and types of industrial wastewater: Environmental impacts, Regulatory requirements, generation rates.	<b>10</b>
<b>SECTION-III</b>	Individual and Common Effluent Treatment Plants – Zero effluent discharge systems Wastewater reuse –Disposal of effluent on land – Quantification, characteristics and disposal of Sludge.	<b>08</b>
<b>SECTION-IV</b>	Waste minimization – Equalization, Neutralization, Oil separation, Flotation, Precipitation, Heavy metal Removal, adsorption, Aerobic and anaerobic biological treatment.	<b>08</b>

**Course Outcome**

<b>CO1</b>	Regulatory requirement applicable to the handling and management of MSW and special category waste.
<b>CO2</b>	Acquiring the knowledge of collection and transportation and solid waste route selection and types of waste collection
<b>CO3</b>	Understanding and appreciating the environmental pollution and nuisance potential of municipal solid waste and of special category wastes.

**Recommended Books:** 1.“Environmental Engg.” By Howard S. Peavy, Donald R. Rowe & GeorgeTehobanoglous, McGraw Hill, International Edition. 1985

2. Arceivala, S. J. and Asolekar, S. R., Wastewater Treatment for Pollution Control, 3rd ed., McGraw-HillEducation (India) Pvt. Ltd. 2016

3. Eckenfelder, W.W., Industrial Water Pollution Control, McGraw Hill 2000

**SUBJECT TITLE: CONSTRUCTION AND MAINTAINNCE MANAGEMENT****SUBJECTCODE: CIV-5-032****SEMESTER: I****CONTACTHOURS/WEEK:**

Lecture(L)	Tutorial(T)	Practical(P)	Credit(C)
3	1	0	4

**Internal Assessment: 40**  
**End Term Exam: 60**  
**Duration of Exam; 3Hrs**

**Objective**

This is a professional subject concerned with the planning, design, construction, and management of infrastructures and socio-economic parameters.

**Contents of Syllabus:**

Sr.No	Contents	Contact Hours
<b>SECTION-I</b>	Services in Residential, commercial and medical buildings (A) Sanitation, water supply, electric wiring, rain water disposal, lighting & illumination, calculation methods for these services (B) Air Conditioning & ventilation: Natural ventilation, control cooling systems, modern systems of air conditioning, ducting Systems, different mechanical means of air conditioning. (C) Fire Safety Dye. (D) Thermal Insulation	16
<b>SECTION-II</b>	Architectural controls and building byelaws: Role of building byelaws in acity, local byelaws and architectural controls, facade control and zoning plans.	10
<b>SECTION-III</b>	Regional planning: Understanding of physical, social and economic parameters for regional planning.	8
<b>SECTION-IV</b>	Landscaping: Forces of man and nature, their relationship and effect on shaping landscape, site analysis.	6

**Course Outcome:**

CO1	Students will be able to make them understand the concepts of Project Management for planning to execution of projects
CO2	Students will be able to make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation
CO3	Students will be able to enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
CO4	Students will be able to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

**Recommended Books:**

NA

**SUBJECT TITLE: COMPOSITE MATERIALS****SUBJECT CODE: CIV-5-035****SEMESTER: I****CONTACT HOURS/WEEK:**

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

**Internal Assessment:40****End Term Exam: 60****Duration of Exam; 3hrs****Objective**

This course is designed to describe the basic understanding of the design requirements for advanced concrete.

Sr.No	Contents	Contact Hours
<b>SECTION-I</b>	Supplementary cementing materials: Types of supplementary cementing materials such as fly ash, silica fume, rice husk ash, and meta kaolin; their physical, chemical, mineralogical properties, effects of these materials on the fresh properties, strength properties, durability properties. Fiber Reinforced Concrete: Definition, types of fibers, properties of fibers, factors affecting FRC, mixing and casting procedure, composite materials approach, effect of fibers on the workability, strength and durability of concretes and applications of different types of fibers	13
<b>SECTION-II</b>	High volume fly ash concrete: Definition, effect of types of fly ash in large quantities on the strength properties of concrete, durability and abrasion resistance of HVFA, applications of HVFA. Self-compacting concrete (SCC): Definition, advantages and disadvantages of SCC, various mix design procedures, tests for SCC; applications for SCC	10
<b>SECTION-III</b>	Behavior of concrete at high temperature: Definition of high temperature, mechanism of concrete failure at high temperature, spalling characteristics, difference in the behavior of normal concrete, high strength concrete and self-compacting concrete at high temperature.	7
<b>SECTION-IV</b>	High performance concrete: Definition of HPC, material selection and its properties, parameters for concrete being considered as HPC, applications of HPC. Polymer Concrete Composites: Definition, types of monomers and polymers, types of polymer concretes and their applications. Fiber reinforced plastics (FRP): Types of FRP, their properties and effects on concrete elements under various loading conditions. Use of waste materials and by-products: Types of waste materials and by-products such as waste glass, scrap tires, waste foundry sand, clean coal ash, etc. Effect of these materials on the various properties of mortar and concrete, introduction of leachates from waste materials and their analysis	19

**Course Outcome:**

CO1	Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
CO2	Analyse the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites
CO3	Apply knowledge of composite mechanical performance and manufacturing methods to a composites design project
CO4	Critique and synthesise literature and apply the knowledge gained from the course in the design and application of fibre-reinforced composites.

**Recommended Books:**

1. Nevelli, A. M., Properties of Concrete, Prentice Hall of India (1995). Siddique, R., SpecialStructuralConcretes
2. Galgotia Publications (2000). Krishna Raju, N., Concrete Mix Design, CBS Publications (2002).
3. Concrete Technology, Tata-McGraw Hill, 3rd Edition (2008).

**SUBJECT TITLE: REMOTE SENSING & GIS****SUBJECT CODE: CIV-5-037****SEMESTER: I****CONTACT HOURS/WEEK:**

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

**Internal Assessment: 40****End Term Exam: 60****Duration of Exam; 3 Hrs****Objective:**

To apply GIS in land use, disaster management, ITS and resource information system

**Contents of Syllabus:**

Sr. No	Contents	Contact Hours
<b>SECTION-I</b>	Energy – electromagnetic radiation, Radiation principles, Electromagnetic spectrum, Ideal remote sensing system, Energy interaction with atmosphere, Atmospheric windows, Energy interaction with earth surface feature, Spectral signature, Multiconcept of remote sensing.	<b>8</b>
<b>SECTION-II</b>	Sensor system – various types of platforms, Different types of sensors, Indian remote sensing systems, Data acquisition, Spatial, spectral and radiometric resolution, Thermal sensors, Fundamentals of microwave remote sensing. Digital image processing – operations involved, Source of image acquisition, Data pre processing – atmospheric, radiometric, geometric corrections, Histograms, Density slicing, Grey level mapping, Contrast stretching, Filtering, Principle component analysis, Basic pattern recognition concepts, Discrimination functions	<b>12</b>
<b>SECTION-III</b>	Data products and Interpretation - various data products, characteristics, Principles of interpretation, Ground control points, Ground truth. GIS – definition, functions of GIS, Types of data – spatial, non spatial, point, line polygon, vector and raster database, Spatial databases, Coordinate systems and georeferencing, Interpolation methods – Deterministic and Statistical, Strategies for development, implementation and management of GIS	<b>12</b>
<b>SECTION-IV</b>	Digitizer, Scanner, Spatial analysis, overlay, query, Sample analysis, modeling in GIS, DEM models and their applications, DTM, Path analysis, Introduction to GIS packages, Projects involving creation of small GIS modules related to water resources and environmental problems	<b>10</b>

## Course Outcome

CO1	analyze raster and vector data and modelling in GIS
CO2	apply the concepts of DBMS in GIS
CO3	apply the concepts of satellite and sensor parameters and characteristics of different platforms

### Recommended Books:

1. Meijerink M.J., HAM de Brouwer, Mannaerts C.M. and Velenzuela C.R. "Introduction to the use of Geographical Information Systems for Practical hydrology", ITC Publication No. 23, UNESCO, Paris
2. Lillesand T.M. and Kiefer R.W. "Remote sensing and Image interpretation", John Wiley & Sons, New York
3. Sweain P.H. and Davis S.M. "Remote sensing – The quantitative approach", McGraw Hill Publications, New York
4. Agarwal C.S. and Garg P.K. "Textbook on Remote Sensing in Natural Resources Monitoring and Management", Wheeler Publishing, Allahabad
5. Keith P.B. and Thompson et al. "Remote sensing and water resources management", American Water Resources Association, Urbana Illinois

**SUBJECT TITLE: ADVANCED FOUNDATION ENGINEERING**

**SUBJECT CODE: CIV-5-038**

**SEMESTER: I**

**CONTACT HOURS/WEEK:**

Lecture(L)	Tutorial(T)	Practical(P)	Credit(C)
3	1	0	4

**Internal Assessment: 40**

**End Term Exam: 60**

**Duration of Exam; 3Hrs**

**Objective**

To enable students select the best foundation solutions for different types of Civil Engineering problems

**Contents of Syllabus:**

Sr.No	Contents	Contact Hours
<b>SECTION-I</b>	Shallow Foundations: Design considerations, factors of safety (including limit state), allowable settlements, location and depth of foundations, Codal provisions. Presumptive bearing, capacity. Bearing capacity theories. Layered soils. shear strength parameters. Bearing capacity from N-values, static cone and plate load tests. Total and differential settlement. Stress distribution. Consolidation settlement in clays (with correction factors). Immediate settlement. Settlement in sands from N-values Static cone and Plate load tests.	10
<b>SECTION-II</b>	Soil structure interaction: Introduction to soil-foundation interaction problems, soil behavior, Foundation behavior, interface behavior, soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.	8
<b>SECTION-III</b>	Deep foundations: Type of Piles. Construction methods. Axial capacity of single piles-static formulae, Skin friction and end bearing in sands and clays. Axial capacity of groups. Settlement of single piles and groups. Uplift capacity. Negative skin friction. Pile load tests. Pile integrity tests. Laterally Loaded Piles: Short and long piles; Free head and fixed head piles; Lateral load capacity of single piles; Lateral deflection; Elastic analysis; Group effect; Lateral load test; Codal provisions. Caissons and Wells.	12
<b>SECTION-IV</b>	Foundations in difficult soils: Expansive soils, chemically aggressive Soil Liquefaction and remedial measures, stone column, deep compaction	8

**Course Outcome:**

<b>CO1</b>	Student would able to perform design of rectangular & trapezoidal combined footing, strao footing and raft foundation
<b>CO2</b>	Student will be capable to analysing the mechanics of load transfer in piles; calculations of pile load carrying capacity
<b>CO3</b>	Student shall be able to calculate load carrying capacity of well foundation and analyse of well foundation
<b>CO4</b>	Student can perform analysis of retaining wall failure under earthquake load

**Recommended Books:**

1. Kaniraj S.K., Design aids in soil mechanics and foundation engineering edition 2016
2. V.N.S. Murthy Advanced foundation Engineering edition 2015
3. John Wiley Joseph E. Bowles Foundation Analysis and Design 2010



**Ph.D. Course Work (Core Subject)**

**Course Name: Latest Trends in Computer Science & Engineering**

**Course Code: PHDCSE 1103 A**

**SEMESTER: I**

**CONTACT HOURS/WEEK:**

<b>Lecture (L)</b>	<b>Tutorial (T)</b>	<b>Practical (P)</b>	<b>Credit (C)</b>
<b>5</b>	<b>0</b>	<b>0</b>	<b>5</b>

**Internal Assessment: 40**

**End Term Exam: 60**

**Duration of Exam: 3 hours**

**Objectives:** On completion of the course, the Research Scholars will be able to:

1. Gain know-how regarding latest trends in the fields of computers and technology.
2. Understand the advancements for software development tools and frameworks.
3. Understand the utilization of cloud computing architecture.
4. Understand the concept of big data tools and analytics.
5. Review network basics along with advanced adhoc networks.

**Course Outcomes:** After the completion of course-work, the candidates will able to:

1. Develop the insight to various methods of software development.
2. Utilize cloud architecture for research applications
3. Understand the management of big data using software tools in research work.
4. Simulate routing algorithms in adhoc networks.

<b>Sr. No</b>	<b>Contents</b>
<b>Unit I</b>	<b>Software Engineering</b> Object oriented Analysis and Design, SDLC, Visual Modelling, UML, Use Case diagrams, Object diagram, Class diagram, Software Reengineering, Reverse Engineering, Clean Room Software Engineering, Project Management, The management spectrum, The People; stakeholders, Software team, Agile teams, CBSE process, CASE tools.

<b>Unit II</b>	<b>Cloud Computing</b> Cloud Computing definition, Cloud Types- Private, Public and Hybrid cloud, Cloud Services: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS), Benefits and challenges of cloud computing.
<b>Unit III</b>	<b>Big Data</b> Introduction to Big Data, Big Data Tools and Techniques, Applications of Big Data, Apache Hadoop, Map Reduce, SMAQ Stack.
<b>Unit IV</b>	<b>Network basics</b> Data communication system and its components, Computer network, Type of Computer Networks: LAN, MAN, WAN, Wired and Wireless system, Network topologies, Congestion control: Principles of Congestion control, Congestion prevention policies, Network security, Cryptography, OSI reference model, TCP/IP reference model
<b>Unit V</b>	<b>Adhoc networks</b> Introduction to Adhoc Wireless Networks, Characteristics of MANETS, Applications of MANETS, challenges, QoS framework for Adhoc Networks, Routing protocols, Design issues, Table driven protocols: DSDV,WRP,CGSR, On demand protocols: DSR,AODV,TORA

### Recommended Books:

1. Roger S. Pressman (2020), Software Engineering: A Practitioner's Approach, 7<sup>th</sup> Edition, Tata McGraw Hill Company, New Delhi.
2. Dreamtech (2015), Big Data, Black Book: Covers Hadoop 2, Mapreduce, Hive, Yarn, Pig, R and Data Visualization, New Delhi.
3. Toby Velte , Anthony Velte and Robert Elsenpeter (2017), Cloud Computing: A Practical Approach, Tata McGraw Hill Company, New Delhi.
4. B.A Forouzan (2017), Data Communications and Networking, Tata McGraw Hill Company, New Delhi.
5. Murthy (2014), Ad Hoc Wireless Networks Architectures And Protocols, Pearson India.