

**JK LAKSHMIPAT UNIVERSITY, JAIPUR**  
**Institute of Engineering and Technology**  
**and**  
**Institute of Management**

**PhD Programme**  
**(Session: 2019-2020)**

**Pre-PhD Course Work**

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**Basic Rules and Regulations, Course Structure,**  
**Detailed Syllabus & Scheme of Examination**

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## Basic Rules and Regulations

1. Credit Requirement in Pre-PhD Course Work:

<b>S. No.</b>	<b>Qualifying Examination</b>	<b>Credits</b>
1.	M. Phil, M. Tech	9
2.	MBA, M. Sc., MCA, M. Com	16
3.	B. Tech	32

2. Research Methodology, Pedagogy, Academic Writing, Credit-2 each course, would be compulsory courses for Pre-PhD Course work. Remaining credits can be earned through elective courses and/or MOOC courses offered by different departments/institutes.
3. Minimum CGPA requirement for passing Pre-PhD Course work is 6.
4. Minimum duration of the PhD Programme would be 3 years and one can complete PhD work within 6 years (UGC Norms).

## Course Structure, Detailed Syllabus & Scheme of Examination

S. No.	Course Code	Course Title	Total Contact Hours	Credits	Target Students	Core/ Elective
<b>Common Core Courses (Engineering and Management)</b>						
1	IL2101	Research Methodology	2 0 0	2	Pre PhD	Core
2	IL2102	Pedagogy	2 0 0	2	Pre PhD	Core
3	IL2103	Academic Writing	2 0 0	2	Pre PhD	Core
<b>Elective Courses in Engineering</b>						
1	AS2102	Algebra of Random Variable	3 0 0	3	Pre PhD	Elective
2	AS2103	Software Reliability	3 0 0	3	Pre PhD	Elective
3	CS2102	Machine Learning and Data Mining	3 0 2	4	Pre PhD	Elective
4	CE2401	Advanced Concrete Technology	12 Weeks	4	Pre PhD	MOOC (NPTEL)
5	CS2401	Advanced Statistics	12 Weeks	4	Pre PhD	Curative MOOC
6	CS2402	Data Structure and Algorithms	12 Weeks	4	Pre PhD	Curative MOOC
7	CE2202	Advanced Highway Materials	3 0 2	4	Pre PhD	Elective
8	AS2201	Multi-Objective Optimization	3 0 0	3	Pre PhD	Elective
9	CS2403A	Introduction to Machine Learning	12 Weeks	4	Pre PhD	Curative MOOC
<b>Elective Courses in Management</b>						
1.	HR16	Organization Behaviour for Research	3 0 0	3	Pre PhD	Elective
2.	HR15	Strategic Human Resource Management	3 0 0	3	Pre PhD	Elective
3.	MK12	Consumer Behaviour for Research	3 0 0	3	Pre PhD	Elective
4.	MK13	Integrated Marketing Communication for Research	3 0 0	3	Pre PhD	Elective

5.	FN13	Financial Risk Management	3 0 0	3	Pre PhD	Elective
6.	FN12	Dynamics of Financial Planning	3 0 0	3	Pre PhD	Elective
7.	OM11	Service Operations Management for Research	3 0 0	3	Pre PhD	Elective
8.	OM12	Supply Chain Management	3 0 0	3	Pre PhD	Elective
9.	EP2102	Economics for Business	3 0 0	3	Pre PhD	Elective
10.	ID2111	Foundation of Data Analysis	3 0 0	3	Pre PhD	Elective
11.	ID2112	Data Analysis for Decisions	2 0 0	2	Pre PhD	Elective
12.	ID2180	Mathematical Thinking	2 0 0	2	Pre PhD	Elective
13.	CC2170	Cognition & Critical Thinking	2 0 0	2	Pre PhD	Elective
14.	BS2221	Specialized Topics in HR	2 0 0	2	Pre PhD	Elective

**CORE AND MANDATORY COURSES FOR ENGINEERING AND  
MANAGEMENT**

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
IL2101	Research Methodology	20	0	0	0	2
<b>Target Students:</b> PhD Scholars.						
<b>Course Objectives:</b> This course aims to familiarize the PhD students with basic elements of research thinking.						
<p>Learning Outcomes:</p> <p>On successful completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>critically analyze the strengths and weaknesses of one's own and other's intellectual work and also write a literature review on a topic.</li> <li>identify, describe, and critique the methods used for research in engineering, management, and development.</li> <li>define research problems from a coherent analysis of gaps in existing knowledge base.</li> <li>formulate hypotheses and/or research questions</li> <li>write research proposals describing research questions, purpose, context, metrics, sources and methodology.</li> <li>undertake research work making systematic use of investigation or experimentation, to discover or revise knowledge of reality.</li> </ol>						
<b>Assessment Scheme:</b>						
<b>Prerequisites : Nil</b>					<b>Research Methodology</b>	
<b>Teaching Scheme</b>					20+ hrs of Lecture, Seminar	
<b>Credit</b>					2	
Sr. No.	Evaluation Component				Marks	
1	Attendance				NA	
2	Assignment				30	
3	Class Participation				10	
4	Quiz				NA	
5	Theory Exam-I				NA	
6	Theory Exam-II				NA	
7	Theory Exam-III				NA	
8	Report-I				30	
9	Report-II				NA	
10	Report-III				NA	
11	Project-I				30	
12	Project-II				NA	
13	Project-III				NA	

14	Lab Evaluation-I	NA
15	Lab Evaluation-II	NA
16	Course Portfolio	NA
	<b>Total (100)</b>	100

**Course Syllabi:**

Ways of knowing, nature of science and philosophy, research competencies, reasoning, critical thinking for researchers, fallacies, common errors in analysis, literature review, nature of theoretical and empirical world, research approaches, research process, research goal, basic research, applied research, empirical research, characteristics of good research, types of research results, framing research proposal, pitfalls in research proposals, ethical issues in research, data collection, sources of evidence,

**Reference and Reference Sources:**

1. Jerry Wellington et al, Succeeding with Your Doctorate, SAGE Publications, 2005
  2. Holyoak, Keith J., and Robert G. Morrison, eds. The Cambridge Handbook Of Thinking And Reasoning. Cambridge University Press, 2005.
  3. McNabb, David E. Research methods for political science: Quantitative and qualitative methods. Routledge, 2004, 2015.
  4. Yin, R. K. 2003. Case Study Research: Design and Methods, 2d Edition. Thousand Oaks, 3rd Edition, CA: Sage Publications.
  5. Patten, Mildred L. Proposing empirical research: A guide to the fundamentals. Part E, Pyczak Pub, 2005
  6. <http://philosophy.hku.hk/think/arg>
  7. <http://158.132.155.107/posh97/private/ResearchMethods/150.htm>
- Many more references will be provided during the courses.

**Facebook Group:** <https://www.facebook.com/groups/746835115749631/>

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
IL2102	Pedagogy	20	0	0	0	2
<b>Target Students:</b> PhD Scholars.						
<b>Course Objectives:</b> This course aims to familiarize the PhD students with modern approaches for teaching university level or continuing professional development courses.						
<p><b>Learning Outcomes:</b>  On successful completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1. Plan appropriate learning outcomes for university level or continuing professional development courses in their discipline wrt the New Education Policy or National Skill Qualification Framework.</li> <li>2. Design a variety of learning activities for university level or continuing professional development courses in their discipline wrt the desired learning outcomes.</li> <li>3. Design appropriate assessment schemes for university level or continuing professional development courses in their discipline wrt the desired learning outcomes.</li> <li>4. Use flipped class room, team-teaching, and project based learning or other approaches of inductive teaching to transform regular university level or continuing professional development courses in their disciplines.</li> </ol>						
<b>Assessment Scheme:</b>						
<b>Prerequisites :</b> Nil					<b>Pedagogy</b>	
<b>Teaching Scheme</b>					20+ hrs of Lecture, Seminar, and Observation of selected classes	
<b>Credit</b>					2	
<b>Sr. No.</b>	<b>Evaluation Component</b>				<b>Marks</b>	
1	Attendance				NA	
2	Assignment				30	
3	Class Participation				10	
4	Quiz				NA	
5	Theory Exam-I				NA	
6	Theory Exam-II				NA	
7	Theory Exam-III				NA	
8	Report-I				30	
9	Report-II				NA	
10	Report-III				NA	



11	Project-I	30
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I	NA
15	Lab Evaluation-II	NA
16	Course Portfolio	NA
	<b>Total (100)</b>	100

**Course Syllabi:**

New Education Policy, NSQF, Levels of Expertise, Cognitive and Moral Development. Learning Styles, Deep learning, Bloom's Taxonomy of educational objectives, Dimensions of Learning, Solo Taxonomy of Educational Objectives, Merrill's Principles of Instruction, Deductive teaching, inductive teaching, flipped class, team-teaching, and hybrid teaching, Social learning theory, Experiential learning, Constructivism, Situated Learning, Problem/Project based learning, etc.

**Reference and Reference Sources:**

1. New Education Policy, 2019
2. NSQF
3. <https://www.learning-theories.com/>
4. <https://gsi.berkeley.edu/gsi-guide-contents/>
5. <https://eric.ed.gov/>
6. <https://tomprof.stanford.edu/>
7. <https://www.engr.ncsu.edu/stem-resources/legacy-site/education/>
8. More specific references will suggested during the coursework.

**Facebook Group:** <https://www.facebook.com/groups/746835115749631/>

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
IL2103	Academic Writing	20	0	0	0	2
<b>Target Students:</b> PhD Scholars.						
<b>Course Objectives:</b> Although they follow a well-defined format, writing scientific articles and getting them ready to be published, can be a difficult task. This course focuses on practicing necessary skills to write good academic prose.						
<b>Learning Outcomes:</b> On successful completion of this course, the students should be able to: 1) write a scientific article to communicate about their research 2) assess the quality of academic writing 3) prepare a scientific article for publication, using different computational tools						
<b>Prerequisites :</b> Nil						
<b>Teaching Scheme</b>					20+ hrs of Lecture, Seminar, and Observation of selected classes	
<b>Credit</b>					2	
<b>Assessment Scheme:</b>						
Sr. No.	Evaluation Component					Marks
1	Attendance					NA
2	Assignment (2)					80
3	Class Participation					10
4	Quiz					10
5	Theory Exam-I					NA
6	Theory Exam-II					NA
7	Theory Exam-III					NA
8	Report-I					NA
9	Report-II					NA
10	Report-III					NA
11	Project-I					NA
12	Project-II					NA
13	Project-III					NA
14	Lab Evaluation-I					NA
15	Lab Evaluation-II					NA
16	Course Portfolio					NA
	<b>Total (100)</b>					100
<b>Course Syllabi:</b>						

The scientific paper. Sections: Title, Authors/Affiliation, Abstract, Introduction, Materials and methods, Results, Discussion, Conclusion, References, Bibliography, Footnotes, Appendix and Acknowledgements.

Tools and techniques for academic writing. Basic guidelines for text, equations, tables, figures, legends, graphs, quotes, references, captions, journal formats, etc. Using version control tools, using reference management tools.

Preparing to publish. Rewriting, final manuscript preparation, analyzing written arguments and responding to referees. Ethics in research and publication. Plagiarism checkers.

### **Reference and Reference Sources:**

- [1] E. Wager and S. Kleinert, "Responsible research publication: international standards for authors. A position statement developed at the 2nd World Conference on Research Integrity," presented at the Promoting Research Integrity in a Global Environment, 2011.
- [2] S. A. Socolofsky, "How to write a research journal article in engineering and science," p. 17.
- [3] M. J. Katz, From research to manuscript: a guide to scientific writing. Dordrecht, The Netherlands: Springer, 2006.
- [4] Zemach Rumisek. Academic Writing, 2005. Macmillan ELT
- [5] S. Bailey, Academic writing: a handbook for international students. London; New York: Routledge Falmer, 2004.
- [6] I. Leki, Academic writing: exploring processes and strategies, 2. ed., 13th print. Cambridge: Cambridge Univ. Press, 2009.
- [7] S. Kaye, Writing under pressure: the quick writing process. New York: Oxford University Press, 1989.
- [8] E. J. Rothwell and M. J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, 1st ed. CRC Press, 2017.
- [9] Silvia, P. J. 2015. Arcana and miscellany: From titles to footnotes. Write it up: Practical strategies for writing and publishing journal articles: 157-174. Washington, DC: American Psychological Association.
- [10] Ballinger, G. A. & Johnson, R. E., 2015. Editor's comments: Your first AMRreview. Academy of Management Review, 40(3): 315-322.
- [11] Kamler, B. 2008. Rethinking doctoral publication practices: Writing from and beyond the thesis. Studies in Higher Education, 33(3): 283-294.
- [12] Alvesson, M. & Sandberg, J. 2011. Generating research question through problematization. Academy of Management Review, 36(2): 247-271.

### **IT Resources:**

Canvas Instructure: <https://canvas.instructure.com/enroll/JRJ33R>

1. Coursera. Academic English: Writing. University of California, Irvine. <https://www.coursera.org/specializations/academic-english>

# **ELECTIVES IN ENGINEERING**

**Course Title: Algebra of Random Variables**

**Course Code: AS2102**

**Teaching Scheme: 3 0 0**

**Credits: 3**

Course Objectives:

To familiarize students with the fundamentals of probability theory, random variables, random processes and algebraic operations on random variables and then finding solutions to some problems which requires applications of algebraic operations to random variables.

Syllabus

#### RANDOM VARIABLES

Random variables, Distribution and density functions of random variables, Discrete and continuous random variables, Gaussian, Exponential, Rayleigh, Uniform, discrete Uniform and conditional distributions, distribution mean, variance, moments and characteristics functions.

#### MULTIPLE RANDOM VARIABLES

Function of two random variables, Distributions of two random variables, correlation coefficient, Joint moments, Joint characteristics functions, Conditional distributions, conditional expected values, statistical independence. Multiple random variables, distribution of sums of random variables, Central limit theorem.

#### DISTRIBUTION OF SUM AND DIFFERENCE OF RANDOM VARIABLES

The Fourier convolution as the distribution of a sum, the distribution of sum and difference of continuous random variables, the distribution of the sum of mixtures of independent random variables.

#### DISTRIBUTION OF PRODUCTS AND QUOTIENTS OF RANDOM VARIABLES

The Mellin convolution and its relation with the distribution of product, the distribution of products and quotients of independent nonnegative random variables, the distribution of the products and quotients of continuous standardized Nonnegative random variables.

#### DISTRIBUTION OF PRODUCTS AND QUOTIENTS OF RANDOM VARIABLES THAT ARE NOT EVERYWHERE POSITIVE

The distribution of product of random variables that are not everywhere positive, the distribution of product of independent normal random variables. The distribution of product of discrete random variables.

## Reference books

1. M.D. Springer, The Algebra of Random Variables, John Wiley & Sons.
2. J. Susan Milton and Jesse C. Arnold, 'Introduction to Probability and Statistics', McGraw Hill Education.
3. Papoulis, 'Probability, Random Variables And Stochastic Processes', TMH.
4. P. Kousalya, Probability, Statistics and Random Processes, Pearson.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
AS2103	Software Reliability	3	1	0	0	4
<b>Course Objectives:</b> This Course aims to develop various concepts and tools to help students understand software metrics and software reliability models.						

### **Course Syllabi (Theory):**

#### **Unit – I: Introduction**

Need for software reliability, Basic definition and terminology, introduction to reliability measures

#### **Unit – II: Software Reliability Modelling**

Introduction, Software metrics and software reliability models, Failure rate models, Reliability growth models, Markov structure models

#### **Unit – III: NHPP Software Reliability Models**

Introduction to Non-homogenous Poisson process models, Parameter estimation, NHPP models

#### **Unit – IV: Fault-tolerant Techniques**

Software fault tolerance, faults, errors and their management strategies, software defense, Fault recovery techniques

<b>Course Title and Code: Machine Learning and Data Mining: CS2102</b>		
Hours per Week		<b>L-T-P: 3-0-2</b>
Credits		<b>4</b>
Students who can take		Pre PhD (2019-2021)
<p><b>Course Objective:</b> This course introduces the fundamental concepts of machine learning and data mining techniques. The course will cover the state-of-the art data mining techniques along with its usage with machine learning algorithms on real-world data (or big data). This course helps the students to pursue project related ML and data mining with real-world research problems.</p>		
<p>Learning Outcome:</p> <p>On successful completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1. Utilize advanced knowledge of data mining, data warehousing and KDD concepts and techniques.</li> <li>2. Organize and Prepare the data needed for data mining using pre-preprocessing techniques.</li> <li>3. Generate and apply different mining techniques such as rule generation, association mining, Bayesian techniques and Frequent Itemset generation.</li> <li>4. Apply the techniques of clustering, classification, association finding, feature selection and visualization on real world data.</li> <li>5. Demonstrate knowledge in scalability and management of large dataset.</li> <li>6. Identify machine learning techniques suitable for a given problem.</li> <li>7. Interpret fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.</li> <li>8. Use the standards and energy efficient ML algorithms.</li> <li>9. Apply dimensionality reduction techniques.</li> <li>10. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.</li> <li>11. Utilize state-of-the art algorithms of Machine Learning for building applications related to SDG.</li> </ol>		
Prerequisites		Linear Algebra, Basic Statistics
<b>Sr. No</b>	<b>Specifications</b>	<b>Marks</b>
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam	10
6	Theory Exam	Nil
7	Theory Exam	30



8	Report-1	10
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	20
16	Course portfolio	Nil
	Total (100)	100

### **Syllabus (Theory)**

**UNIT – I:** Introduction: Data warehouse – Difference between Operational DBs and Data warehouses – Multidimensional Data Model, The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

**UNIT – II:** Techniques of Data Mining: Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining, Association Analysis: Problem Definition; Frequent Itemset generation; Rule Generation; Compact representation of frequent itemsets; Alternative methods for generating frequent item- sets

**UNIT – III:** Issues in Data Mining: Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in Knowledge Discovery in Databases (KDD) and data mining, pitfalls of KDD and data mining.

**UNIT – IV:** Introduction to Machine Learning, Supervised Learning: Classification: Preliminaries; General approach to solving a classification problem; Decision tree induction; Rule-based classifier; Simple and Multiple Linear Regression ; Nearest-neighbor classifier, SVM, Unsupervised Learning: Clustering; K-Means, Hierarchical Clustering

**UNIT – V:** Model Evaluation Measures: Cross-Validation Technique, Confusion matrix for evaluation, Class probabilities and class predictions, ROC Curve, Model evaluation metrics, Fitting dataset and evaluating their performance set, Evaluation of selected features, Model evaluation metrics, making predictions on new data; Usage of AI and ML Techniques for achieving sustainable practices, NIST and IEEE standards for AI and ML libraries, tools and techniques

### **Reference Books:**

1. Mitchell, Tom. Machine Learning, McGraw Hill 1997.
2. Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012. (Electronic copy available through the Bodleian library.)

3. Bishop, Christopher M. Pattern recognition and machine learning. Springer, 2006.
4. Han, Jiawei, Jian Pei, and Micheline Kamber. Data mining: concepts and techniques. Elsevier, 2011.
5. Tan, Pang-Ning, Michael Steinbach, Vipin Kumar, and Anuj Karpatne. Introduction to Data Mining, Global Edition. Pearson Education Limited, 2019.
6. Witten, Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal. Data Mining: Practical machine learning tools and techniques. Morgan Kaufmann, 2016.

**Course Code: CS2401**

**Course Name: Advanced Statistics**

**Credits: 4**

**Course Offered to:** Pre Ph.D (Curated MOOC)

**Course Description:** This course will introduce and explore various statistical modeling techniques, including linear regression, logistic regression, generalized linear models, hierarchical and mixed effects (or multilevel) models, and Bayesian inference techniques. All techniques will be illustrated using a variety of real data sets, and the course will emphasize different modeling approaches for different types of data sets, depending on the study design underlying the data, Understanding and Visualizing Data with Python.

**PREREQUISITES:** Linear Algebra, Basic Statistics

**Evaluation Scheme:**

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam I	20
6	Theory Exam II	Nil
7	Theory Exam III	40
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	Nil
16	Course portfolio	Nil
	Total (100)	100

**COURSE CONTENTS:**

**Overview & Considerations for Statistical Modeling, Fitting Models to Independent Data, Fitting Models to Dependent Data, Case Studies, Assignments & Lab Sessions**

**SUGGESTED READING MATERIALS:**

This course is part of the **Statistics with Python Specialization** Offered by **University of Michigan** through **Coursera**. Student may refer course notes, videos & ppts. Advanced Statistics text books as optional background material.

**Course Code: CS2402**

**Course Name: Data Structure and Algorithms**

**Credits: 4**

**Course Offered to:** Pre Ph.D (Curated MOOC)

**Course Description:** This course will introduce Advanced Algorithms and Complexity. Essentially, a linear programming problem needs to optimize a linear function of real variables constrained by some system of linear inequalities. This course will study the classical NP-complete problems and the reductions between them. Also practice solving large instances of some of these problems despite their hardness using very efficient specialized software based on tons of research in the area of NP-complete problems. It will first show that some special cases on NP-complete problems can, in fact, be solved in polynomial time then consider exact algorithms that find a solution much faster than the brute force algorithm. This course will conclude with approximation algorithms that work in polynomial time and find a solution that is close to being optimal.

**PREREQUISITES:** Linear Algebra, Basic Statistics

**Evaluation Scheme:**

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam I	20
6	Theory Exam II	Nil
7	Theory Exam III	40
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	Nil
16	Course portfolio	Nil
	Total (100)	100

**COURSE CONTENTS:**

Advanced Algorithms and Complexity, Linear Programming, NP-complete Problems, Coping with NP-completeness & Flows in Networks, Case Studies, Assignments & Lab Sessions.

**SUGGESTED READING MATERIALS:**

This course is part of the Data Structures and Algorithms Specialization Offered by **UNIVERSITY OF CALIFORNIA SAN DIEGO and NATIONAL RESEARCH UNIVERSITY HIGHER SCHOOL OF ECONOMICS** through **Coursera**. Student may refer course notes, videos & ppts. Advanced Data Structures & Algorithms textbooks as optional background material.

**Course Title: Advanced Concrete Technology (NPTEL)**

**Course Code: CE2401**

**Duration: 12 weeks**

**Credit: 4**

**Syllabus:**

Cement Chemistry & Aggregates for concrete

Chemical and mineral admixtures

High performance concrete proportioning Tests for

fresh concrete and hardened concrete Creep and

shrinkage in concrete

Durability of concrete

<b>Course Title and Code: Advanced Highway Materials CE2202</b>	
Hours per Week	<b>L-T-P: 3-0-2</b>
Credits	<b>4</b>
Students who can take	<b>M.Tech. &amp; Ph.D.</b>

### **Course Syllabus:**

**Introduction:** Components of pavement structure, functions of subgrade, subbase, base course and wearing courses.

**Soil:** Classification, identification and strength tests, soil moisture movement, sub-soil drainage, soil stabilization.

**Aggregates:** Classification, physical and strength characteristics with MORTH specifications, proportioning of aggregates, skid resistance and polishing of aggregates. Sustainable materials as aggregates for green highways.

**Bitumen:** Bitumen sources and manufacturing, Bitumen constituents, structure & Rheology, Tests on bitumen and MORTH specifications, Emulsions – types & properties, Adhesion of bitumen, Modified bitumen.

**Bituminous Mixes:** Desirable properties of mixes, various bituminous mixes used in India, Design of bituminous mixes, tests on bituminous mixes, Fillers and their specifications.

**Cement Concrete Mixes:** Constituents and their requirements, Physical and structural properties of concrete, Factors influencing mix design, Design of concrete mixes, Specifications of concrete as per IRC:58 for concrete pavements. Sustainable materials for concrete pavements.

### **List of Practicals:**

1. Identification tests on soils (Sieve analysis and Atterburg limits)
2. Compaction test on subgrade soil
3. CBR test on subgrade soil
4. Strength tests on aggregate

5. Aggregate polishing and skid resistance test (demonstration)
6. Granular Sub Base (GSB) mix design
7. Elastic recovery test on binder
8. Marshall bituminous mix design
9. Concrete Mix Design

**Suggested books:**

1. Highway Engineering by S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Bros., Roorkee.
2. Hot Mix Asphalt: Materials, Mixture Design and Construction by Freddy L. Roberts, National Asphalt Pavement Association, Research and Education Foundation, Lanham, Maryland.
3. Principles of Transportation Engineering by Partha Chakroborty & Animesh Das, PHI, New Delhi.
4. Bituminous Road Construction in India by Prithvi Singh Kandal, PHI Learning Private Limited, Delhi.
5. Principles of Transportation Engineering by Partha Chakroborty & Animesh Das, PHI, New Delhi.
6. Highway Materials and Pavement Testing by S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Bros., Roorkee.
7. Specifications for Road and Bridge Works, Fifth Revision, Ministry of Road Transport and Highways (MORTH), Indian Roads Congress, New Delhi.
8. Relevant IRC and IS codes



**Course Code:** AS 2201

**Course Title:** Multi-objective Optimization

**Teaching Scheme:** 3 0 0

**Credits:** 3

**Course Overview:**

This is an introductory course to multi-objective optimization. It will start with the details and mathematical models of problems with multiple objectives. This course includes most fundamental concepts in the field of multi-objective optimization covering conventional and evolutionary methods.

**Course Plan:**

Optimality concept, Introduction to multi-objective optimization, comparison of single objective optimization and multi-objective optimization, Non-linear programming Weighted sum method,  $\epsilon$ -constraint method, No-preference Methods, Posteriori Methods, Priori Methods  
Goal programming, Dominance relations, Dominance partial order, Pareto optimality  
Introduction to Evolutionary Computation: Biological and artificial evolution, different historical branches of EC, a simple genetic algorithm. Search Operators: Crossover, mutation, crossover and mutation rates, Crossover for real-valued representations, mutation for real-valued representations  
Applications of multi-objective optimizations

**References:**

1. Wayne L. Winston, Operations Research: Applications and Algorithms. Duxbury Press, 2003.
2. Godfrey C. Onwubolu and B. V. Babu. New optimization techniques in engineering. Springer, 2004.
3. K. Deb. Multi-objective optimization using evolutionary algorithms. Chichester, UK: Wiley; 2001.
4. Osyczka A. Evolutionary algorithms for single and multicriteria design optimization. Heidelberg: Physica-Verlag; 2002.

<b>Course Title and Code: Introduction to Machine Learning, CS2403A</b>		
<b>Hours per Week</b>	<b>Curated MOOC</b>	
Credits	4	
Students who can take	<b>Pre-Ph.D, Post Graduate, Under graduate</b>	
<p><b>Course Objective:</b> With the increased availability of data from varied sources there has been increasing attention paid to the various data driven discipline such as analytics and machine learning. This course introduces concepts of machine learning from a mathematically well motivated perspective. Different learning paradigms and some of the more popular algorithms and architectures used in each of these paradigms would be covered in the course.</p>		
<p><b>Learning Outcome:</b> On successful completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1. Identify machine learning techniques suitable for a given problem.</li> <li>2. Interpret fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.</li> <li>3. Apply dimensionality reduction techniques.</li> <li>4. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.</li> <li>5. Apply Suitable Machine Learning Technique.</li> <li>6. Build Neural Network for Prediction</li> <li>7. Utilize Reinforcement Learning concepts to improvise precision of models.</li> </ol>		
<p><b>Prerequisites: Linear Algebra, Basic Statistics, Programming Language</b></p>		
<p><b>Evaluation Scheme</b></p>		
<b>Sr. No</b>	<b>Specifications</b>	<b>Marks</b>
1	Attendance	Nil
2	Assignment	40
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam I	Nil
6	Theory Exam	15
7	Theory Exam (End Term)	25
8	Report-1	Nil

9	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	10
15	Lab Evaluation2	10
16	Course portfolio	Nil
	<b>Total (100)</b>	<b>100</b>

### Retest

1	Theory Exam	25
2	Lab Evaluation	10

### Course Contents:

Probability Theory, Linear Algebra, Convex Optimization - (Recap), Introduction:  
Statistical Decision Theory - Regression, Classification, Bias Variance

Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component, Partial Least squares

Linear Classification, Logistic Regression, Linear Discriminant Analysis, Perceptron, Support Vector Machines

Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization,  
Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation

Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures

Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting

Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks

Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation

Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Gaussian Mixture Models, Expectation Maximization, Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods, Applications)

**Suggested Reading Materials:**

**The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman (freely available online)**

**Pattern Recognition and Machine Learning, by Christopher Bishop**

This course would be delivered on SWAYAM from 27th January, 2020 to 17th April, 2020 by Prof. Balaraman Ravindran, Professor in Computer Science at IIT Madras and Mindtree Faculty Fellow Student may refer course notes, videos & ppts.

# **ELECTIVES IN MANAGEMENT**

**Course Title and Code:** Organization Behaviour for Research, HR16

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

The course is designed to help the students to understand that organizational effectiveness is more than the sum of the individual and group effectiveness. Through synergistic effects, organizations obtain higher levels of effectiveness than sum of their parts. Managerial process is inherently a human process-people relating to people which establishes the importance of understanding human behaviour in the workplace. The focus of this course is on the characteristics common to all organizations: the behaviour of individuals, groups and the processes that give viability to organizations

**Learning Outcomes:**

On completion of the course the students will have the ability to

1. Analyze individual and group behaviour, and understand the implications of organizational behaviour on the process of management.
2. Evaluate the appropriateness of various leadership styles and conflict management strategies used in organizations.
3. Demonstrate a thorough knowledge and understanding of organizational behaviour. Collaboratively and autonomously research, analyze and evaluate information from a wide variety of sources.
4. Apply relevant contemporary theories, concepts and models in order to analyse organisational environments, cases and issues.

**Course Content:**

1. Introduction to Organizational Behavior
2. Globalization, Diversity and Ethics
3. Personality and Perception
4. Motivation and its application
5. Positive Organizational Behavior and Psychological Capital
6. Dynamics of Group behavior: Groups and Teams
7. Transactional Analysis
8. Leadership, Power and Politics
9. Organizational Culture
10. Change Management.

### Suggested Readings

1. Don Hellriegel and John W. Slocum, Jr. (2004). **Organizational Behavior**. India: Thompson
2. James L. Gibson. John M. Ivancevich (2006) **Organizations**. Singapore: McGraw- Hill
3. Jerald Greenberg and Robert A. Baron (2008). **Behavior in Organizations**. New Delhi: Pearson Prentice Hall
4. Luthans, Fred (2011). **Organizational Behaviour: Evidence- Based Approach**. Singapore: McGraw Hill.
5. Stephen P. Robbins & Timothy Judge (2010). **Essentials of Human Behavior**. New Delhi: Pearson Education

### Evaluation scheme:

<b>Assessment Criteria</b>	<b>Percentage</b>
Presentation	20%
Quiz and Assignments	20%
<b>Minor Project</b>	<b>20%</b>
<b>Theory Exam</b>	<b>40%</b>
<b>Grand Total:</b>	<b>100%</b>

**Course Title and Code:** Strategic Human Resource Management, HR15

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

The course aims at developing an understanding of how the human resource management function can become a strategic partner in organization and business management. It would help to learn to define the deliverables of a strategically aligned human resource function in organizations and give an exposure to research in the field of strategic human resource management practices. The course is divided into three modules.

**Learning Outcomes:**

By the end of this module you will be able to:

1. Explain the purpose of strategic planning in an organisation
2. Demonstrate the ability to explain the importance of people in the achievement of strategic change
3. Understand the key areas of human behaviour in sustained organisational performance.
4. Consider the changing nature of human resource management (e.g. outsourcing, issues around the future of nature of work)

**Course Content:**

1. Course Introduction
2. Strategy and Human Resource Management.
3. Organization Environments, Organizational Effectiveness
4. Building Organizational Capability through People.
5. Strategic Performance Management.
6. Strategic Compensation Designs.
7. Employee Relationship Management.
8. HR Systems and Organization Performance.
9. Human Resource Strategy for a Competitive Advantage,

**Suggested Readings:**

1. Tanuja,A.,(2013), Strategic Human Resource Management, Oxford University Press, New Delhi.
2. Armstrong Michael and Baron Angel (2005), Handbook of Strategic Human Resource Management : The Key to Improved Business Performance, Mumbai: Jaico Publishing House
3. Boxall Peter & Purcell John (2 ed.) (2008), Strategy and Human Resource Management, New York :Palgrave Macmillan.



### Additional Readings

1. Boxall, P., & Purcell, J. (2000). Strategic human resource management: where have we come from and where should we be going?. *International Journal of Management Reviews*, 2(2), 183-203.
2. Crawshaw, J. R., Budhwar, P., & Davis, A. (2014). *Human Resource Management: Strategic and International Perspectives*. London: Sage.
3. Guest, D. E. (2011). Human resource management and performance: still searching for some answers. *Human Resource Management Journal*, 21(1), 3-13.
4. Legge, K. (2005). *Human Resource Management: Rhetorics and Realities*. (Anniversary Edition). Basingstoke: Palgrave Macmillan

### Evaluation Scheme:

Assessment Criteria	Percentage
Presentation	20%
Quiz	10%
Assignments	20%
Minor Project	20%
Theory Exam	30%
Grand Total:	100%

**Course Title and Code:** Consumer Behaviour for Research, MK12

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

Consumer behavior is one of the most interesting and important aspects of marketing management. Virtually all decisions involved in developing an effective marketing mix for a product or service rely on thorough knowledge of the consumers who comprise the target market. Understanding the behavior of the consumer can help marketers anticipate reactions to changes in the marketing mix, or determine whether new products are likely to be adopted. Consumer behavior is also closely related to marketing research. A practical understanding of the consumer can aid in the selection of an appropriate research methodology, question design and selection, as well as in interpreting consumer responses to such questions. In this course we will directly examine the available theory and research concerning the behavior of the consumer in order to understand its most basic principle

**Learning Outcomes:**

Upon completion of the course, scholars are expected to be able to:

- Appreciate the value of consumer behaviour in determining successful marketing strategies.
- Review recent conceptual, empirical, and methodological developments in research on consumer behaviour.
- Develop coherent framework for interpreting consumer reactions to marketing stimuli.
- Apply behavioural principles to analyze marketing problems and design marketing strategy.

**Course Content:**

1. Understanding Consumer and market segments
2. Consumer Motivation
3. Personality traits and Consumer Behaviour
4. Consumer perception
5. Theories of Consumer Learning
6. Consumer Attitude Formation and Change
7. Consumer Decision Making Process
8. Culture, Subcultures, Social Class, Reference Group and Family Influences
9. Personal Influences and Diffusion of Innovation

**Suggested Readings:**

1. Schiffman, L.G., Wisenblit, J., & Kumar, R. S. (2015). *Consumer Behavior*. New Delhi: Pearson Education.
2. Blackwell, R., Miniard, P. W., Engel, J. F., (2008). *Consumer Behavior*. New Delhi, Cengage Learning.
3. Evans, M., Foxall, G., & Jamal, A. (2009). *Consumer Behavior*. New Delhi: Wiley Indian Edition.
4. Hawkins, D. I., Motherbaugh, D. L., & Mookerjee, A. (2014). *Consumer Behavior:*

*Building Marketing Strategy*. New Delhi: McGraw-Hill Education.

5. Kapoor, R. (2012). *Consumer Behaviour: Text and Cases*. New Delhi: McGraw Hill Education.
6. Krishna, R. (2014). *Consumer Behaviour*. New Delhi, Oxford University Press

**Evaluation Scheme:**

**Evaluation Scheme:**

Assessment Criteria	Percentage
Continuous Assessment	40%
Presentation	20%
Quiz and Assignments	20%
Minor Project	20%
Theory exam	40%
Grand Total:	100%

**Course Title and Code:** Integrated Marketing Communication for Research, MK13

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

Communication is a key skill for anyone involved in any aspect of marketing, not to mention almost every other aspect of business. The average person thinks of marketing communications as advertisements. This popular, narrow conception of marketing is not surprising given that these are the most common marketing activities with which the average person has direct experience. The scope of this course, however, will reflect the full breadth of the integrated marketing communications discipline. This course is intended to provide an overview and some experience with the creation and analyses of promotional strategies. This course is designed to be valuable to students who desire to work specifically in the communications field, in a broader marketing role or pursue their doctoral in marketing management.

**Learning Outcomes:**

By the end of the course the student would be able to:

- Recognize the importance of integration and analytics in the marketing communication process
- Emphasize the stature and importance of IMC as it is practiced against a backdrop of ever-changing social, economic and competitive developments in local, regional, national and global markets
- Apply IMC principles and practices to develop a comprehensive IMC plan for a brand.
- Evaluate the methods marketers can use to evaluate the effectiveness of an IMC campaign.
- Introduce, practice and manage integrated marketing communication and analytics in their organizations.

**Course Content:**

1. Integrated Marketing Communications- Objectives, Components and Effectiveness of Communication Process.
2. Integrated Marketing Communication (IMC) Components (Promotion Mix), IMC Planning Process
3. Communication Objectives and Budgeting.
4. Advertising Management: Meaning, Nature and Scope of Advertising, Role of Advertising in Promotion Mix, Various Participants in IMC Process-Role of Advertising Agencies
5. Analysis of Consumer Behavior, Segmentation, Targeting and Positioning Strategies
6. Advertising Management: Meaning, Nature and Scope of Advertising, Role of Advertising in Promotion Mix, Various Participants in IMC Process-Role of Advertising Agencies
7. Analysis of Consumer Behavior, Segmentation, Targeting and Positioning Strategies
8. Message Strategies- Creative Strategy Planning, Development and Implementation
9. Media Strategies- Planning and Implementation, Evaluating Effectiveness of Advertising.
10. Ethical and Social Issues in Advertising; Role of Promotional Tools in Marketing Communication, Role of Support Media
11. Personal Selling, Direct and Interactive Marketing, Events and Experiences, Internet Marketing, Ethical, Social and Legal Issues in Marketing.

**Suggested Readings:**

**Books:**

1. Belch, G. E., Belch, M. A., & Purani, K. (2014). *Advertising and Promotion: An Integrated Marketing Communication Perspective*. New Delhi: McGraw Hill Education.
2. Chunawalla, S. A. & Sethia, K. C. (2010). *Foundations of Advertising- Theory & Practice*. New Delhi: Himalaya Publishing House.
3. Clow, K. E., & Baack, D. E. (2015). *Integrated Advertising, Promotion and Marketing Communications*. Noida, U.P.: Pearson Education
4. Ryan, D. & Jones, C. (2012). *Understanding Digital Marketing*. USA: Kogan page.
5. Shah, K., & D’Souza, A. (2014). *Advertising & Promotions: An IMC perspective*. New Delhi: McGraw Hill Education.

**Journals:**

1. Almquist, E. & Wyner, G. (2001), “Boost Your Marketing ROI with Experimental Design,” *Harvard Business Review*, 79(9), 5-11.
2. Keller, K. L. (2009), “Building Strong Brands in a Modern Marketing Communications Environment,” *Journal of Marketing Communications*, 15 (2-3), 139-155
3. McCracken, G. (1989), “Who is the Celebrity Endorser? Cultural Foundations of the Endorsement Process,” *Journal of Consumer Research*, 16(3), 310-321.
4. Shavitt, S., Johnson, T. P., & Zhang, J. (In press) "Horizontal and Vertical Cultural Differences in the Content of Advertising appeals", *Journal of International Consumer Marketing*. Click "Horizontal and vertical cultural differences in the content of advertising appeals" <http://business.illinois.edu/shavitt/publications.html>

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Percentage</b>
Presentation	20%
Quiz and Assignments	20%
Minor Project	20%
Theory exam	40%
<b>Grand Total:</b>	<b>100%</b>

**Course Title and Code:** Financial Risk Management, FN13

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

Financial Risk Management is an elective course for PhD students of Finance area. It is designed to help students acquire expert-level knowledge of principles and practices of risk management in financial services. Topics covered in this course have both theoretical and practical significance because risk management is a central theme of financial management. An understanding of these concepts is essential for analyzing a wide range of topics. It is expected to be a pre-requisite for research work on problems of financial risk management.

**Learning Outcomes:**

After completion of the course, the student will be able to

1. Demonstrate expert-level knowledge of financial risk management
2. Design risk management strategies using financial derivatives
3. Describe the key issues and research problems in financial risk management

**Course Content:**

1. Uncertainty and risk
2. Value at risk
3. Approaches to risk management
4. Mechanics of derivatives markets
5. Futures: mechanics and risk management
6. Options: mechanics and risk management
7. Investment strategies
8. Swaps
9. Credit derivatives

**Suggested Readings:**

1. John .C. Hull. (2014). *Options and Futures*. New Delhi: Pearson Publication Ltd.
2. Kolb, Robert W. (2014), *Understanding Options*, John Wiley & Sons Inc.
3. Sundaram Janakiraman. (2011). *Derivatives and Risk Management*. New Delhi: Pearson Publication Ltd

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Percentage</b>
<b>Continuous Assessment</b>	<b>40%</b>
Presentation	20%
Quiz and Assignments	20%
<b>Minor Project</b>	<b>20%</b>
<b>Theory exams</b>	<b>40%</b>
<b>Grand Total:</b>	<b>100%</b>

**Course Title and Code:** Dynamics of Financial Planning, FN12

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

Financial Planning is process of framing objectives, policies, procedures, programmes and budgets regarding the financial activities of a concern or a person. This ensures effective and adequate financial and investment policies. This course helps in developing an insight in the new age financial planning process both at organizational and personal finance level. Financial Planning helps in ensuring a reasonable balance between outflow and inflow of funds so that stability is maintained. It ensures that the suppliers of funds are easily investing in companies which exercise financial planning. Financial Planning helps in reducing the uncertainties which can be a hindrance to growth of the company or own funds. This helps in ensuring stability and profitability.

**Learning Outcomes:**

By the end of the course the student would be able to:

1. Recognize the importance of financial planning for business concern,
2. Understand various tools and techniques of financial planning at the corporate level, and
3. Evaluate the methods and applications in personal financial planning

**Course Content:**

1. Planning Process: Introduction to the Financial Planning Process, Life Cycle Planning, Personal Financial Statements and Budgeting, Emergency Fund Planning,
2. Credit and Debt Management, Buying vs. Leasing,
3. Financial Planning for Various Business Entities
4. Legal Environment of Financial Planning: Business Law, Function, Purpose and Regulation of Financial Institutions, Financial Services Industry Regulation Requirements,
5. Investments: Introduction to Fixed Income Securities, Formula Investing and Investment Strategies, Asset allocation and portfolio diversification, Efficient Market Theory (EMT),
6. Tax consequences of Sale of Assets, Tax compliance, Alternative Minimum Tax (AMT),
7. Personal Financial Planning: Retirement Planning and Employee Benefits
8. Estate Planning : Methods of property transfer at death, Estate planning documents, Gifting strategies, Gift taxation and compliance, Satisfying liquidity needs, Powers of appointment,
9. Behavioural Finance, Inflationary considerations on investment strategy.



**Suggested Reading:**

1. NISM and FPCIL (2011). Certified Personal Financial Advisor's Workbook. Mumbai: NISM & FPCIL  
Sinha, M. (2008). Financial Planning : A Ready to Reckoner. New Delhi: McGraw Hill Education
2. Beniwal, H. (2013). Financial Life Planning: Solve Your Biggest puzzle. New Delhi: Network 18 Publications
3. Chauhan, M. (2013). 16 Personal Finance Principles Every Investor Should Know. New Delhi: Network 18 Publications

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Percentage</b>
<b>Continuous Assessment</b>	<b>40%</b>
Presentation	20%
Quiz and Assignments	20%
<b>Minor Project</b>	<b>20%</b>
<b>Theory exam</b>	<b>40%</b>
<b>Grand Total:</b>	<b>100%</b>

**Course Title and Code:** Service Operations Management for Research, OM11

**Hours per Week:** 3

**Credits:** 3

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**Course Description:**

This course explores the dimensions of successful service firms. Outstanding service organizations are managed differently than their "merely good" competitors. Actions are based on totally different assumptions about the way success is achieved. The results show not only in terms of conventional measures of performance but also in the enthusiasm of the employees and quality of customer satisfaction. Beginning with the service encounter, service managers must blend marketing, technology, people, and information to achieve a distinctive competitive advantage. This course will study service management from an integrated viewpoint with a focus on customer satisfaction. The study material will integrate operations, marketing, strategy, information technology and organizational issues from research perspective.

**Learning outcomes:**

On completion of course the students will be able to:

1. Understanding of various research designs and techniques involved in management & operations of service for organizations
2. Develop insight in the new age service operations processes both in manufacturing and service firms
3. Analyze challenges of service operations management, generated during effective service delivery and strategies
4. Critically review the published materials related to service operations management

**Course Content:**

1. Nature of Service
2. Service Strategy
3. Service delivery system
4. Supporting facility
5. Service encounter

6. Service location facility
7. Service quality
8. Managing queues
9. Productivity and quality improvement

**Suggested Readings:**

- Chun, H. L., Chu, C.W., & Yueh, H. L. (2008) Revisit service classification to construct a customer-oriented integrative service model, *International Journal of Service Industry Management*, 19 ( 5), 639 – 661.
- Chris ,V., Helen, P. , Rui, S. , Lars, W., & Nancy,V.W. (2016) Reflections on context in service research , *Journal of Service Management*, 27 ( 1),30 – 36
- Chiara, O. , Jens, H.,& Andrea, O. (2016). Building on the past: advancing theory in services through meta-analysis, *Journal of Service Management*, 27( 1).37 – 42
- Kiane,G.,Sylvie, L.,& Chiara,O. (2015). Crossing boundaries in service research: the La Londe Service Conference, *Journal of Service Management*, 26 ( 5)
- Magnus, S., & Sara, R., (2008). Revisiting the smiling service worker and customer satisfaction, *International Journal of Service Industry Management*, 19 ( 5), pp.552 – 574
- Yoonjung, A., Sungjoo, L.,& Yongtae, P, (2008). Development of an integrated product service roadmap with QFD: A case study on mobile communications, *International Journal of Service Industry Management*, 19 ( 5), 621 – 638.

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Percentage</b>
Presentation	20%
Quiz and Assignments	20%
Minor Project	20%
Theory exam	40%
<b>Grand Total:</b>	<b>100%</b>

**Course Title and Code: Supply Chain Management, OM12**  
**Hours per Week: 3**  
**Credits: 3**

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**Course Description:**

This course explores the interdisciplinary dimensions of supply chain management and strategic importance of good supply chain design, planning and operations in the economic development of a nation. Understanding how good supply chain management can be a competitive advantage, whereas weakness in supply chains at various levels can damage the performance of a firm and affect the economy. Within the strategic framework of SCM the course identifies facilities, inventory, transportation, information, sourcing and pricing as the key drivers of supply chain performance.

**Learning Outcomes:**

On completion of course the students will be able to:

1. Understand analytical & methodological tools essential for solving SCM issues
2. Analyze major issues, risks and interrelationship of them for better Supply chain performance
3. Evaluate various aspects of supply chain management & challenges generated during effective management of supply chains

**Course content:**

1. Introduction & Supply Chain Performance measures
2. Logistics Network Configuration
3. Inventory Management and Risk Pooling
4. The Value of Information
5. Supply Chain Integration
6. Shipment
7. International Issues in Supply Chain Management

## Suggested Readings:

- || Stefan, S. (2013). A review of modeling approaches for sustainable supply chain management. *Decision Support Systems*, 54 (4), 1513–1520.
- || Matthew, A. W., & Stanley, E. F. (2013). Data Science, Predictive Analytics, and Big Data: A Revolution That Will Transform Supply Chain Design and Management. *Journal of Business Logistics*, 32(4), 77-84.
- || Lambert, M.D., & Cooper, M.C. (2000). Issues in Supply Chain Management. *Industrial Marketing Management*, 29(1), 65–83.
- || Srivastava, S.K., & Bansal, S. (2013). Measuring and Comparing Volume Flexibility across Indian Firms. *International Journal of Business Performance Management*, 14(1), 38-51.
- || Srivastava, S.K. (2012). Managerial Implications from Indian Case Studies on e-Reverse Auctions. *Business Process Management Journal*, 18(3), 513-531
- || Laeequddin, M., Sahay, B.S., & Sahay. (2011). Supply Chain Partner’s Perceptions of Trust and Risk- the Perspectives of UAE Printing and Packaging Industry. *International Journal of Information System & Supply Chain Management* (IGI-Global), Vol. 4, Iss.1, pp. 60-76.

## Evaluation Scheme:

Assessment Criteria	Percentage
Presentation	20%
Quiz and Assignments	20%
Minor Project	20%
Theory exam	40%
<b>Grand Total:</b>	<b>100%</b>

**Course Title and Code: Economics for Business, EP2102**

**Hours per Week: 3**

**Credits: 3**

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**Course Description:**

*Economics for Business* provides a solid foundation for economic analysis and thinking. Concepts and models of the course apply to Finance, Marketing, Operations, Strategy, Human Resource Management, Politics, Public Policy, History, and many other fields, and form the basis for managerial decision making.

**Learning Outcomes:**

By the end of this course, students should be able to understand:

- Demand, Supply, Equilibrium, Pareto optimality
- Elasticity and its relationship with pricing and revenue
- Economics of production
- Economic costs for decisionmaking
- Different types of market structures (e.g., Perfect Competition, Monopoly, Duopoly)
- Basic models of Game Theory
- Pricing
- Market Failures
  - Public Goods
  - Externalities
  - Moral Hazard
  - Adverse Selection
- The role of government in correcting market failures. Of particular interest is the effect of taxes and government policies on markets.
- Applications of economic principles to policy questions

**Course Content:**

1. Gains from Trade
2. Supply, Demand and Equilibrium
3. Elasticity & its Applications
4. Supply, Demand and Government Policies
5. Costs
6. Perfect Competition
7. Monopoly
8. Pricing and market segmentation
9. Oligopoly

## 10. Market Failures

### Suggested Readings

- Principles of Economics with Course Mate by N. Gregory Mankiw (Cengage)
- A set of videos at

[https://www.youtube.com/watch?v=g9uUIUqhrSQ&list=PL-uRhZ\\_p-BM4XnKSe3BJa23-XKJs\\_k4KY](https://www.youtube.com/watch?v=g9uUIUqhrSQ&list=PL-uRhZ_p-BM4XnKSe3BJa23-XKJs_k4KY)

### Evaluation Scheme

<b>Assessment Criteria</b>	<b>Weightage (100)</b>
Quiz 1	20%
Assignments	20%
Midterm	25%
End term	35%

**Course Title and Code: Foundation of Data Analysis, ID2111**

**Hours per Week: 3**

**Credits: 3**

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**Course Description:**

Organizational decision-making in present times is increasingly becoming data-driven. Hence, it is essential for a management student to develop necessary skills in analyzing business data. A firm understanding of fundamental statistical concepts is a precondition for developing these skills. The present course is offered to help you in building a foundation for developing these skills. The course begins with an introductory module on key spreadsheet skills. It then introduces participants to the core concepts in probability theory and statistical inference. The course focuses on building a starter statistical toolbox with appreciation for both the utility and limitations of these techniques. The course on one hand makes you an informed consumer of statistical information and at the same time prepares you for further coursework in the fascinating area of analytics.

**Learning Outcomes:**

Upon successful completion, the student should be able to:

- Understand and appreciate the role of data analysis in business decisions.
- Use spreadsheet software to perform exploratory data analysis.
- Set up and work with discrete and continuous random variables.
- Know what expectation, variance and covariance mean and compute them.
- Understand binomial, poisson and normal distributions and their properties.
- Compute estimates of population from samples and assess their accuracy.
- Calculate sample size required for any desired level of precision in estimation.

**Course Content:**

Spreadsheet Essentials:

1. Excel Environment
2. Formatting & Linking Worksheets
3. Formulas and Functions
4. Charting.

Statistical Methods and Techniques:

1. Data Description
2. Exploratory Data Analysis
3. Probability and Probability Distributions
4. Sampling and Sampling Distribution
5. Estimation



**Suggested Readings:**

- Levin, R.I., Rubin, D.S., Rastogi, S., & Siddiqui, M.H. (Latest Edition). *Statistics for Management*. Delhi: Pearson. [Text Book].
- Davis, G., & Pecar, B. (Latest Edition). *Business Statistics using Excel*. Delhi: Pearson.
- Carlberg, C. (Latest Edition). *Statistics Analysis: Microsoft Excel 2013*. Noida: Pearson.
- Black, K. (Latest Edition). *Applied Business Statistics: Making Better Business Decisions*. Delhi: Wiley India.

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Weightage (100)</b>
Quiz/ Exercise	10%
Group Assignments	25%
Participation	5%
Midterm Exam	20%
End term Exam	40%
Total	100%

**Course Title and Code: Data Analysis for Decisions, ID2112**

**Hours per Week: 2**

**Credits: 2**

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**Course Description:**

Data-driven organizational decision-making requires a management student to develop necessary skills in analyzing business data. The present course is the second course in a two-course series (Pre-requisite: Foundation of Data Analysis) and builds upon the foundation skills developed during the previous course. The course starts with hypothesis testing and then progresses through various inferential statistical techniques, such as correlation and regression analysis, to help participants develop the necessary skills in applying statistical techniques in managerial decision-making situations.

**Learning Outcomes:**

Upon successful completion, the student should be able to:

- Formulate hypotheses and collect data for testing of hypotheses.
- Test hypotheses using various parametric and non-parametric statistical tests.
- Apply simple and multiple regression techniques to predict unknowns.

**Course Content:**

1. Hypotheses Testing
2. Chi-Square and ANOVA
3. Correlation and Covariance
4. Simple and Multiple Regression
5. Non-Parametric Tests

**Suggested Readings:**

- Levin, R.I., Rubin, D.S., Rastogi, S., & Siddiqui, M.H. (Latest Edition). *Statistics for Management*. Delhi: Pearson. [Text Book].
- Davis, G., & Pecar, B. (Latest Edition). *Business Statistics using Excel*. Delhi: Pearson.
- Carlberg, C. (Latest Edition). *Statistics Analysis: Microsoft Excel 2013*. Noida: Pearson.
- Black, K. (Latest Edition). *Applied Business Statistics: Making Better Business Decisions*. Delhi: Wiley India.

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Weightage (100)</b>
Assignment	20%
Quiz and Exercises	10%
Participation	10%
Mid Term Exam	20%
End Term Exam	40%
Total	100

**Course Title and Code: Mathematical Thinking, ID2180**

**Hours per Week: 2**

**Credits: 2**

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**Course Description:**

The purpose of this course is to explore mathematics as an idiom of thought. This idea goes further from understanding math as merely a technique, and explores the subject as an independent mode of inquiry. Students often believe they dislike mathematics by the time they come to college. Some students fear math. Some just loathe it. This course aims to bring mathematics to the students, as it philosophically is, not what it appears to be. In other words, the objective of the course is to develop sensitivity and appreciation towards logical reasoning which is manifested in looking at the world through numbers, frames, quantitative design and therefore develop interest in math-based subjects that student may want to engage in, later. That said, the course may not act as a prerequisite for other advanced courses relying on mathematics, but it definitely forms an introduction to mathematical thinking, to generate interest in it in the first place. It frames solid base of applying mathematics in everyday thinking.

The course will demonstrate how mathematics is the language of nature. Students will approach mathematics not only as a set of problems, but also as a natural as well as social phenomenon. The course will also approach mathematical inquiry as a means for exploring both the physical sciences and social sciences with examples ranging from genetics, computer science, linguistics, design, abstract reasoning, cartography, formal and informal logic. The course does not assume students to have had a background in mathematics, and therefore has a foundational promise, with swift possibilities to build advanced concepts over them.

**Learning Outcomes:**

Students, by the end of the course should be able to think and develop mental faculties with respect to the following frames of imagination:

- a. Inductive and deductive reasoning
- b. Building a mathematical formulation or a picture in head, about a non-mathematical problem
- c. Heightened sensitivity towards understanding logic
- d. Abstract thinking about infinitesimally small distances, and theorize on thought experiments
- e. Idea of randomness
- f. Create distorted representation of pictorial figures if asked
- g. Tricks to find the important idea amongst all the good and bad ideas bundled up together
- h. Basic mathematical literacy to understand some symbolic representation
- i. Ability to convert symbols into sentences and the other way round
- j. Question and critique on logic
- k. Sensitivity for proofs
- l. Perceive the foundational applications of AI, ML
- m. Appreciate the nondeterministic nature of this world, alongside powers of numerical precision

### Course Content:

1. Mathematics in Nature
2. Logic
3. Number System and Set Theory
4. Graph Theory
5. Geometry
6. Fair Distribution
7. Introduction to philosophy of calculus
8. Index numbers

### Suggested Readings

1. Angel, A. R., & Porter, S. R. (2009). A survey of mathematics with applications. Pearson Addison Wesley.
2. D.J. Struik (1942), On the Sociology of Mathematics, Science & Society, Guilford Press
3. Dantzig, T. (2007). Number: The language of science. Penguin.
4. Edward Burger and Michael Starbird (1999), The Heart of Mathematics: An Invitation to Effective Thinking, Key College
5. G.H.R. Parkinson and H.G. Shanker, Routledge History of Philosophy: Philosophy of Science, Logic and Mathematics in the 20th Century, London: Routledge (select chapters)
6. Gel'fand, S. I. et. al. (2002). Sequences, combinations, limits (Vol. 3). Courier Corporation.
7. Gerard Alberts (1994), On Connecting Socialism and Mathematics: Dirk Struik, Jan Burgers and Jan Tinbergen, Historia Mathematica
8. H.J.M. Bos and H. Mehrtens (1977), The Interaction of Mathematics and Society in History Some Exploratory Remarks, Historia Mathematica
9. Jack C. Gill & Robert Blitzer, Competency in College Mathematics, H&H Publishing, Clearwater Florida (select chapters)
10. John Tabak, Mathematics and the Laws of Nature: Developing the Language of Science, New York: Facts on File
11. Karl J. Smith, The Nature of Mathematics (12e), Little, Brown
12. Keith Devlin (2012), Introduction to Mathematical Thinking
13. Kline, M. (1967). Mathematics for liberal arts. Addison-Wesley Pub. Co..
14. Marcia Ascher (1984), Mathematical Ideas in Non-western Culture, Historia Mathematica
15. McGinnis, R. (1965). Mathematical foundations for social analysis. The Bobbs-Merrill.
16. Mitchell, Melanie (2009). Complexity: A guided tour. Oxford University Press.
17. Ore, O. (1990). Graphs and their uses (Vol. 34). Cambridge University Press.
18. Paulus Gerdes (1994), On Mathematics in the History of Sub-Saharan Africa, Historia Mathematica
19. Polya, G. (1954). Induction and analogy in Mathematics, Princeton University Press
20. Polya, G. (2014). How to Solve It: A New Aspect of Mathematical Method: A New Aspect of Mathematical Method. Princeton university press.
21. Sarukkai, S. (2005). Revisiting the 'unreasonable effectiveness' of mathematics. Current science, 88(30), 415-423.

22. Sarukkai, S. (2003). Applying mathematics: The paradoxical relation between mathematics, language and reality. *Economic and Political Weekly*, 3662-3670.

**Evaluation scheme**

<b>Assessment Criteria</b>	<b>Weightage (100)</b>
Written assessment	40
Presentation	40
Class Participation	20

**Course Title and Code:** Cognition and Critical Thinking, CC2170  
**Hours per Week:** 2  
**Credits:** 2

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**Course Description:**

The course aims to provide a macro level understanding of the principles critical thinking and improve cognitive behaviour in the context of sustainability.

**Learning Outcomes:**

On completion of the course the students will be able to

1. Understand the principles of sustainability and how they apply to business / life
2. Appreciate the elements of critical thinking and how they help in creative problem solving
3. Raising vital questions and importance of articulation to receive accurate data
- 4 Translate data into useful and well-reasoned information
5. Apply the elements of critical thinking to build more sustainable business and systems

**Course Content:**

- 1 Introduction to Sustainability: Three pillars of Sustainability. SDGs and how they apply to organisations and individuals. Importance of being sustainable in work and life.
2. Sustainability and Behaviour Change: Key elements of conservation psychology and behaviour change strategies as well as community engagement tools that are designed to produce results.
3. Measurement of change: Theory of Change, Logic model framework, essentials of measuring sustainability and social change. Difference between Outputs and Outcomes. How to question

**Suggested Readings:**

1. <https://open.umn.edu/opentextbooks/textbooks/sustainability-a-comprehensive-foundation>
2. [https://www.academia.edu/36997171/Critical\\_Thinking\\_for\\_Global\\_Peace\\_A\\_key\\_for\\_Sustainable\\_Development](https://www.academia.edu/36997171/Critical_Thinking_for_Global_Peace_A_key_for_Sustainable_Development)
3. [http://samples.jbpub.com/9781449645311/14867\\_ch01\\_chiras.pdf](http://samples.jbpub.com/9781449645311/14867_ch01_chiras.pdf)
4. Courtice, P. 'The critical link: strategy and sustainability in leadership development', in CPSL

(2012) *The Future in Practice – the State of Sustainability Leadership*, University of Cambridge Programme for Sustainability Leadership, Cambridge. [http://digital.edition-on.net/links/6431\\_the\\_future\\_in\\_practice\\_cpsl.asp](http://digital.edition-on.net/links/6431_the_future_in_practice_cpsl.asp)

5. Gore, A (2013) *The Future*, W.H. Allen, New York.

6. SDSN (2103) *An Action Agenda for Sustainable Development – Report for the UN Secretary-General, Leadership Council of the Sustainable Development Leadership Council.*

<http://unsdsn.org/resources/publications/an-action-agenda-for-sustainable-development/>

**Evaluation Scheme:**

Each student will be assessed on class participation and one written assignment/ presentation. The aim is to understand comprehension level of students on the topics taught so far and their ability to apply.

<b>Assessment Criteria</b>	<b>Weightage</b>
Assignment	25%
Presentation	25%
Exercise	25%
Class Participation	10%
Quiz	15%
<b>Total</b>	<b>100</b>



**Course Title and Code:** Specialized Topics in HR, BS2221

**Hours per Week:** 2

**Credits:** 2

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**Course Description:**

The course intends to immerse students into more specialized and trending topics in the area of HR. Organizations are continuously evolving in dynamic business environment and likewise people management is undergoing change to address the challenges of business. Delving deep into emerging topics in HR will strengthen the students' understanding about the changing landscape HR and help them identify area which require more investigative research in present times. The exposure to the emerging topics will also provide needed expertise and knowledge in the domain to peruse research. The students will be undergoing related MOOC courses to enrich the learning and fortify their foundation.

**Learning Outcomes:**

At the end of the course the students will be to:

- i. Develop deeper knowledge and expertise in HR
- ii. Analyze the relevance of specialized topics in changing landscape of business
- iii. Identify newer and relevant avenues of research

**Course Content:**

1. Employee engagement
2. Employee agility
3. Employer Branding
4. Diversity, equity and inclusion
5. Knowledge management
6. Alternative Workforce
7. Employee mental health and wellness
8. Workplace mindfulness
9. Digital transformation in HR
10. Ethics and Future of work
11. Sustainability and HR

**Suggested readings:**

Management/ Business Magazines, Journal, Research databases related to the specialized topics.

**Evaluation Scheme:**

<b>Assessment Criteria</b>	<b>Percentage</b>
Presentation	20%
Quiz	10%
Assignments	20%
Minor Project	30%
Theory exam	20%
<b>Grand Total:</b>	<b>100%</b>

