

**CCE-PROFICIENCE**  
**INDIAN INSTITUTE OF SCIENCE, BENGALURU 560012**



**INFORMATION HAND BOOK**  
**January – May 2020**

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## REGULAR COURSES

Sl. No.	Name of the Course	Credit
1.	Innovative Product Development and Design Methods (Mon)	2+0
2.	Augmented and Virtual Reality (Tue)	2+0
3.	Commercializing Intellectual Property (CIP) (Tue)	2+0
4.	Linear Optimisation (Tue)	2+0
5.	Business Analytics with Management Science Models and Methods (Tue-Thur)	3+0
6.	Vibration and Noise: Theory and Practice (Wed)	2+0
7.	Analysis and Design of Composite Structures (Thur)	2+0
8.	Introduction To Numerical Methods for Fluid Flow Computations (Thur)	2+0
9.	Mathematics for Data Science (Thur)	2+0
10.	Deep Learning: Theory and Practice (Thur)	2+0
11.	Online Course on Deep Learning: Theory and Practice (Thur)	2+L
12.	Introduction to Robotics (Thur)	2+0
13.	Structural Analysis and Design Optimization: Theory and Practice (Fri)	2+0
14.	Project Management (Fri)	2+0
15.	Pattern Recognition (Sat) (10 am – 12 noon)	2+0
16.	Basics of Data Analytics (Sat) (10 am – 12 noon)	2+0
17.	Online Course on Basics of Data Analytics (Sat) (10 am – 12 noon)	2+L
18.	Mathematical Foundations for Machine Learning (Sat) (10 am – 12 noon)	2+0
19.	Nonlinear Finite Element Method (Sat) ( 10 am – 12 noon)	2+0

20.	Image Processing & Computer Vision (Sat) (10 am – 1 pm)	3+0
21.	Reinforcement Learning (Sat) (10 am – 12 noon)	3+0
22.	Online Course on Reinforcement Learning (Sat) (10 am – 1pm)	3+L
23.	Start-up Tools (SuT), (Sat) (10 am – 1 pm)	3+0
24.	Strategic Management (Sat) (10 am – 1pm)	3+0
25.	Introduction to Industrial Design (Sat) (1 pm – 4 pm)	3+0
26.	Power System Protection (Sat) (1 pm – 4 pm)	3+0
27.	Deep Reinforcement Learning (Sat) (2 pm – 4 pm)	2+0
28.	Online Course on Deep Reinforcement Learning (Sat) (2 pm – 4 pm)	2+L
29.	Classical and Mathematical Physics (Sat) (2 pm – 4 pm)	2+0
30.	Basic Concepts of Finite Element Method (Sat) (2 pm – 4 pm)	2+0
31.	Basics of Machine Learning (Sat) (2 pm – 4 pm)	2+0
32.	Probability Foundations for Machine Learning (Sat) (2 pm – 4 pm)	2+0

## INTRODUCTION

Indian Institute of Science (IISc) established in 1909, is a Deemed University and Centrally Funder Technical Institution under the Department of Higher Education, Ministry of Human Resources Development, Government of India. Rapid strides in science and technology make it imperative that the education of professionals be continued over their entire career rather than be confined to a single *stretch*. What is needed is a complete integration of education with work during their productive life span, which will be adequate to help them cope with new demands. Continuing Education embraces all the processes of education that one undergoes throughout a working life and which have a relevance to the practical problems likely to be encountered in one's career. It may be realized through formal and informal modes of teaching, or through mass media. In recent years, there has been a growing awareness on the part of Universities that imparting knowledge to people beyond their boundaries is an equally important part of their service to the community. With this broad perspective of their function in society, Universities have begun to seek ways of reaching out to professionals. The IISc has evolved several mechanisms to make the expertise and facilities available to qualified technical people in industries, Universities and research establishments. The need for forging links between academic institutions and industries and R&D organizations has been a goal set for the IISc by its illustrious founder, J.N. Tata. CCE-PROFICIENCE was established with the objective of providing a sustained and rigorous continuing education program offering courses on subjects of topical interest to scientists and engineers in and around Bangalore. This program, believed to be the first of its kind in the country, is a joint venture between IISc and several Professional Institutions/Societies in Bangalore. The program name signifies the coming together of Professional Institutions and the Indian Institute of Science. It was started on an experimental basis in 1980 and has proved to be extremely popular and has attracted wide attention in academic and professional circles. The demand for some courses, especially on computers, microprocessors and management is so overwhelming that it has not been possible to admit all the Eligible applicants. Every year, there has been a steady increase in the number of students as well as the types of courses offered indicative of the growing popularity of this Program. IISc is the custodian of the academic standards of all CCE-PROFICIENCE courses. It has the responsibility of evolving appropriate teaching norms, providing the venue and facilities for conducting courses, organizing the tests and examinations and issuing certificates to the successful participants. These tasks are coordinated by the Centre for Continuing Education (CCE).

## COURSES

Continuing education program organized under CCE-PROFICIENCE offers semester long courses in areas of topical interest. The courses are organized during evening hours so that working professionals can participate without getting their normal work affected. All courses are normally at the postgraduate level and many of these are in fact offered to the IISc students regularly. Participants in certain selected courses are provided practical training in computer and other laboratories, as appropriate. The course contents are regularly upgraded on the basis of feedback from the faculty and the participants. Courses are offered during the period AUG-DEC and JAN-MAY and around 15-20 courses are scheduled during each semester. Each course has lectures at the rate of two or three hours per week depending upon the number of course credits. Tests and examinations are conducted according to the IISc norms. A series of courses leading to different specializations are offered in a sequential manner, especially in the area of Computer

Science and Engineering. This would enable the participants who start with the entry level courses progress towards more advanced ones and specialize in one of the streams.

## **EVALUATION**

The total marks for assessment will be equally distributed between the seasonal work and end semester examination. The seasonal work consists of class tests, mid semester examination, and homework assignments etc. as determined by the instructor. The participants who maintain a minimum of 75% attendance both in the theory and computer/laboratory classes will be evaluated based on the combined performance in the end semester examination and seasonal work and assigned a letter grade.

## **NO RE-EXAMINATION SHALL BE CONDUCTED UNDER ANY CIRCUMSTANCES.**

**The letter grades carry a 10 point grading assessment as indicated below**

**Grade:            A+ A B+ B C D F (Fail)**

**Grade Points:   10 9 8 7 6 5 0**

## **CERTIFICATES**

Certificates will be issued only to those who get at least a 'D' grade. Attendance certificates shall not be issued to anyone. This being a continuing education program meant especially for self-improvement, the credits accumulated cannot be equated with the credits earned through formal education. There shall be no claims for CCE-PROFICIENCE credits being counted towards partial fulfillment of credit requirements towards any degree/diploma or other formal recognitions offered by IISc.

Formal Course completion certificates will not be issued under any circumstances to any candidate.

## **FACULTY**

The instructors for the courses are mostly Institute Faculty. However, competent professionals from other R&D organizations and industries are also involved in teaching some of the courses.

## **REGULAR COURSES**

Computer Lab: A Computer Laboratory with adequate computer machines and a Silicon Graphics work station with a variety of latest software have been set up for the CCEPROFICIENCE program. All these machines have been locally networked. A good collection of video cassettes pertaining to several courses is also available for viewing at the Centre for the participants.

Library: CCE-PROFICIENCE participants can avail of the facility of IISc Main Library and they can also make use of the books in CCE. The books at both the IISc Main Library and CCE are meant only for reference. The participants can avail of this facility by producing their ID card issued by CCE-PROFICIENCE.

**Timings: IISc. Library – 8.00 am - 9.00 pm**

# **INSTRUCTIONS**

## **HOW TO APPLY:**

Details of the courses are available online at [cce.iisc.ernet.in](http://cce.iisc.ernet.in) and also download CCE App from Google Playstore. Essential Qualification for any course is a degree in Engineering or a postgraduate degree in Science/Humanities as applicable with pre-requisites. Each participant will be admitted for a Maximum of Two Courses. Applying to courses is strictly through online portal of CCE. Please read all the instructions provided at our portal before applying. Payment of course fee is through payment gateway provided at our online portal and no other means of payment is accepted. The course fee is Rs. 5000/- per credit and registration fee is Rs. 300/- per course. Any other gateway charges must be borne by participant during online payment. For each application, participants must upload (BE, B.Tech / Post Graduation) Convocation/Degree Certificate without fail. (Class conducted: Week days 6 pm. to 8 pm) & (Saturday's 10 am to 1 pm & 2 pm to 4 pm)

## **FEES**

The course fee is Rs. 5000/= per credit. Some of the courses include a limited exposure to computer operation and programming / Lab Fee (C). The additional fees of this are Rs. 5,000/- The course fee and laboratory fee should be paid in full at the time of joining the course.

## **REFUND OF COURSE FEE**

Refund of course fee will not be made, unless the course is withdrawn officially, in which case, the course fee paid will be refunded in full. Application registration fee once paid will NOT BE REFUNDED under any circumstance. Refund of fees in case of dropped courses will take minimum 3-4 weeks.

## **CLASSES**

Classes will be held in the Lecture Hall Complex of IISc. Lectures will be between 6.00 p.m. and 8.00 p.m. Monday through Friday and between 10 a.m. to 1 p.m. and 2pm to 4 pm on Saturday's

## **LABORATORY CLASSES**

The timings and days for laboratory classes will be fixed in the second week of the respective months (August & January) after the complete registration is known. This will be done, keeping in view the convenience of the faculty and all the students of the courses with laboratory component.

## **RESULTS**

Results of the courses will be announced normally around 1st week of January for August-December term and 1st week of May for January-May term. Certificates will be issued on or after the date of announcement of results and against surrendering the Identity Card.

## **IDENTITY CARD**

Participants will be issued identity cards which should be shown on demand. The participants who have successfully completed should surrender the ID card at the time of receiving

certificate, failing which the certificate(s) will not be issued to her/him. Police authorized by lodging and compliant and then request the Section Officer, CCE to issue duplicate ID during submitting police compliant and Rs.100/- on penalty In the event of loss of identity card, the matter should be immediately reported to the Officer-in-Charge, CCE-PROFICIENCE in writing.

**NO REQUEST FOR CHANGE OF EITHER THE STIPULATED DATES, MODE OF PAYMENT, CHANGE OF COURSE OR SUBMISSION/VERIFICATION OF ENCLOSURE TO APPLICATION ETC., WILL BE ENTERTAINED UNDER ANY CIRCUMSTANCE**

Sl. No.	Name of the Course	Credit	Faculty	Department
1	Innovative Product Development and Design Methods (Mon)	2+0	Dr. J E Diwakar (Retd.) & Prof. P. Achutha Rao (Retd.)	CPDM & NID R&D Campus
2	Augmented and Virtual Reality (Tue)	2+0	Dr. Pradipta Biswas	CPDM
3	Commercializing Intellectual Property (CIP) (Tue)	2+0	Dr. R N Narahari &	CeNSE
4	Linear Optimisation (Tue)	2+0	Dr. Tarun Rambha	Civil Engineering,
5	Business Analytics with Management Science Models and Methods (Tue-Thur)	3+0	Dr. M Mathirajan	MS
6	Vibration and Noise: Theory and Practice (Wed)	2+0	Dr. S B Kandagal	AE
7	Analysis and Design of Composite Structures (Thur)	2+0	Dr. G Narayana Naik	AE
8	Introduction To Numerical Methods for Fluid Flow Computations (Thur)	2+0	Dr. P S Kulkarni, (Retd.)	AE
9	Mathematics for Data Science (Thur)	2+0	Dr. Gopal Krishna Sharma, Dr. Badarinath Ambati & Prof. M Sekhar	Fiserv India Ltd., Altair Engineering, & Civil Engg.
10	Deep Learning: Theory and Practice (Thur)	2+0	Dr. Sriram Ganapathy	EE
11	Online Course on Deep Learning: Theory and Practice (Thur)	2+L	Dr. Sriram Ganapathy	EE
12	Introduction to Robotics (Thur)	2+0	Dr. Abhra Roy Chowdhury	CPDM
13	Structural Analysis and Design Optimization: Theory and Practice (Fri)	2+0	Dr. S B Kandagal	AE
14	Project Management (Fri)	2+0	Dr. J E Diwakar (Retd.) & Prof. TVP Chowdry	CPDM & CST
15	Pattern Recognition (Sat) (10 am – 12 noon)	2+0	Prof. M Narasimha Murthy	CSA
16	Basics of Data Analytics (Sat) (10 am – 12 noon)	2+0	Dr. Gopal Krishna Sharma, Dr. Badarinath Ambati & Prof. M Sekhar	Fiserv India Ltd., Altair Engineering, & Civil Engg.
17	Online Course on Basics of Data Analytics (Sat) (10 am – 12 noon)	2+L	Dr. Gopal Krishna Sharma, Dr. Badarinath Ambati & Prof. M Sekhar	Fiserv India Ltd., Altair Engineering, & Civil Engg.
18	Mathematical Foundations for Machine Learning (Sat) (10 am – 12 noon)	2+0	Mr. M Krishna Kumar, (Retd), Dr. Ashok Rao & Dr. Arulalan	DESE & NIT, Surathkal.
19	Nonlinear Finite Element Method (Sat) ( 10 am – 12 noon)	2+0	Prof. P C Pandey (Retd.) IISc.	Emeritus Professor, Reva University
20	Image Processing & Computer Vision (Sat) (10 am – 1 pm)	3+0	Dr. Kunal Narayan Chaudhury	EE
21	Reinforcement Learning (Sat) (10 am – 12 noon)	3+0	Prof. Shalabh Bhatnagar	CSA
22	Online Course on Reinforcement Learning (Sat) (10 am – 1pm)	3+L	Prof. Shalabh Bhatnagar	CSA
23	Start-up Tools (SuT), (Sat) (10 am – 1 pm)	3+0	Dr. R N Narahari	CeNSE
24	Strategic Management (Sat) (10 am – 1pm)	3+0	Prof. R Srinivasan	MS
25	Introduction to Industrial Design (Sat) (1 pm – 4 pm)	3+0	Dr. J E Diwakar, (Retd.) Prof. P. Achutha Rao, (Retd.) & Prof. TVP Chowdry	CPDM, NID R&D Campus & CST
26	Power System Protection (Sat) (1 pm – 4 pm)	3+0	Dr. Sarasij Das	EE
27	Deep Reinforcement Learning (Sat) (2 pm – 4 pm)	2+0	Prof. Shalabh Bhatnagar	CSA
28	Online Course on Deep Reinforcement Learning (Sat) (2 pm – 4 pm)	2+L	Prof. Shalabh Bhatnagar	CSA
29	Classical and Mathematical Physics (Sat) (2 pm – 4 pm)	2+0	Dr. Tanmoy Das	Physics
30	Basic Concepts of Finite Element Method (Sat) (2 pm – 4 pm)	2+0	Prof. P C Pandey (Retd.) IISc.	Emeritus Professor, Reva University
31	Basics of Machine Learning (Sat) (2 pm – 4 pm)	2+0	Dr. Gopal Krishna Sharma, Dr. Badarinath Ambati & Prof. M Sekhar	Fiserv India Ltd., Altair Engineering, & Civil Engg.
32	Probability Foundations for Machine Learning (Sat) (2 pm – 4 pm)	2+0	Prof. R Vittal Rao, (Retd). Dr. Ashok Rao, & Dr. Arulalan	MATH, DESE & NIT, Surathkal



## **FEE STRUCTURE AT A GLANCE**

### **Regular Courses**

**Per Credit: Rs.5, 000/-**

**Computer Lab Fee: Rs.5, 000/-**

- 1. Course with 2 credits# Rs. 10,000/-**
- 2. Course with 2+C credits # Rs. 15,000/-**
- 3. Course with 3+0 credits # Rs. 15,000/-**
- 4. L Stands with 2+L Credits # Rs. 15,000/-**

**# Credits = Lecture Hours per week**

**\$C Stands for Computer Laboratory**

**\$L Stands for Online Course**

# 1. Innovative Product Development and Design Methods (2+0)

## Objectives:

The globalization and digital connectivity have forced many organizations to look at the way new products are to be developed for customer acceptance in the changed competitive “global village”. Proven methods of the past which made many companies succeed in the “Sellers’ Market” are no longer valid. The organizations have to develop new approaches for design and innovation to meet the challenges of technology explosion and to increase the speed of development.

There is an urgent need to adopt integrated innovative product development strategies to meet the ever-changing customer expectations. This Course, through theory classes, aims to look at these issues and create an awareness of innovative product development process and various design methods to achieve success.

## Syllabus:

- Creativity and Innovation
- Integrated Product Development
- Product Design
- Industrial design
- Quality Function Deployment
- Value Engineering
- Design to Cost
- Design for Assembly and Manufacture
- Design for Service
- Failure Modes and Effects Analysis
- TRIZ (Systematic Innovation) - Overview
- Concept Generation Methods
- Concept Selection Methods

## Target Group:

Practicing Engineers, Managers involved in New Product development, Design and Development in Industries, R & D Organizations etc., Academic Personnel in teaching/practicing Product design, Product engineering, Design and Development and fresh engineers interested in Design and Innovation.



### Faculty:

**Dr. J E Diwakar (Retd.)**  
CPDM.,  
IISc., Bengaluru.  
Email: [jed@iisc.ac.in](mailto:jed@iisc.ac.in)



### Faculty:

**Prof. P Achutha Rao**  
Retired from NID R & D Campus,  
Bengaluru.  
E-Mail: [raopanambur@gmail.com](mailto:raopanambur@gmail.com)

## Reference Books:

1. Merle Crawford, Anthony Di Benedetto  
New Products Management, Tata McGraw Hill  
Education Private Limited, 2011.
2. Robert G Cooper;  
Winning at New Products, Basic Books, 2011.
3. Jonathan M. Cagan, Craig M. Vogel  
Creating Breakthrough Products: Innovation from  
Product Planning to Program Approval;  
FT Press, 2010.
4. Karl Ulrich and Steven Eppinger,  
Product Design and Development, McGraw- Hill/  
Irwin; 5 Editions, May 2011.

## Who Can apply?

Graduation in Engineering, Design (B.Des) &  
Post-Graduation Management

**Course Fee:** Rs. 10,000/-

**Schedule:** Monday's 6.00 pm. to 8.00 pm.

## 2. Augmented and Virtual Reality (2+0)

### Objectives:

- Introducing Importance and Applications of Augmented and Virtual Reality Systems
- Explaining Working Principle of Head Up and Head Mounted Display Systems
- Using Computer Vision to Develop AR Systems
- Developing VR Models in Unity
- Integrating different Sensors with AR/VR Systems
- Teaching different Interaction Modalities (eye gaze, gesture and voice) for AR/VR systems
- Hands on Training on Developing AR/VR Systems
- Undertaking Representative AR/VR projects

### Syllabus:

- History and differences between Augmented and Virtual Reality
- Basics of Computer Vision and Multimodal Interaction
- AR Systems for Fault Inspection, Digital Twin
- Head Up and Head Mounted Systems in Automotive and Aviation Domains
- Virtual Reality System Development in Unity
- Rendering Real Time Sensor Data in VR Model
- Human Robot Interaction using AR/VR Systems

### Target Group:

Industry, R&D Units.



### Faculty:

**Dr. Pradipta Biswas**

Assistant Professor, CPDM, IISc.

E-mail: [pradipta@iisc.ac.in](mailto:pradipta@iisc.ac.in)

### Reference Books:

1. Grigore C. Burdea, Philippe Coiffet ,  
Virtual Reality Technology,  
Wiley 2016
2. Dieter Schmalstieg and Tobias Höllerer, Augmented  
Reality: Principles & Practice,  
Pearson Education India, 2016
3. Norman K (Ed),  
Wiley Handbook of Human Computer Interaction,  
Wiley 2017

### Who can apply?

BE, B.Tech., MCA

### Pre-requisites:

Basic Knowledge of Computer Programming &  
Mathematics

**Course Fee:** Rs. 10,000/-

**Schedule:** Tuesday's 6 pm to 8 pm

### 3. Commercializing Intellectual Property (CIP) (2+0)

#### Objectives:

Introduction to the broad field of Intellectual Property Rights (IPR) in brief including Indian IP laws. To train participants- Scouting for IP in research work; patents genesis to current day trend, drafting provisional/final specs. Forms of IP. Strategic decision on PCT filing, creation of business proposal and commercialization of IP/start up.

#### Syllabus:

Scouting for IP in the research work; Discovery V/s invention. Inventive ideas to vendible products with IP Protection. Various types of IP; patenting an Invention - disclosure to drafting Claims, strategic decision of filing PCT application, creation of business proposal - stages of product development of finances, start-up initiatives, registration of company and so on.

#### Target Group:

All engineers and scientists in R&D establishments, Science and Engineering colleges and industry who have a stake in creating IP.



#### Faculty:

**Dr. R.N. Narahari**

CeNSE

IISc., Bengaluru.

Email: [naraharirn@iisc.ac.in](mailto:naraharirn@iisc.ac.in)  
[narahari.rn@gmail.com](mailto:narahari.rn@gmail.com)

#### Reference Books:

1. John Mullins  
The New Business Road Test: What Entrepreneurs and Investors should do before Launching a Lean Start-up; Person India Education Services PL, Noida, 2019.
2. Taraporevala, V J  
“Law of Intellectual Property”  
Published by Taraporevala. V J, Mumbai, 2005.
3. Prabuddeha R Ganguli,  
“IPR – Unleashing the knowledge Economy”,  
Tata McGraw Hill, New Delhi. 2001.

#### Who Can apply?

BE/B.Tech./Master in Science//Commerce.

**Course Fee:** Rs. 10,000/-

**Schedule:** Tuesday's - 6.00 pm. to 8.00 pm.

## 4. Linear Optimisation (2+0)

### Objectives:

This course aims at Formulating practical Problems as Optimisation Models, Particularly Linear Programming Models, and Solving them using Algebraic Modeling Tools. Application with include Examples from Transportation, Industrial Engineering & Management.

### Syllabus:

Formulating Optimisation Problems; Geometric Methods; Convexity; Simple Method; Sensitivity Analysis; Duality; Dual Simplex; Integer programs; Branch-and-Bound; Applications.

### Case Studies

### Target Group:

Manufacturing and Logistics e-commerce and Mobility Companies, Scheduling (Airlines, Crew etc.).



### Faculty:

**Dr. Tarun Rambha**

Assistant Professor,  
Dept. Of Civil Engineering,  
IISc., Bengaluru.

E-mail: [tarunrambha@iisc.ac.in](mailto:tarunrambha@iisc.ac.in)

### Reference Books:

1. Dimitris Bertsimas, John N. Tsitsiklis  
Introduction to Linear Optimisation,,  
Athena Scientific 1997.
2. George B Dantzig, Mukund N Thapa  
Linear Programming 1,  
Springer 2010.
3. Alexander Schrijver  
Theory of Linear and Integer Programming  
Wiley 1998.
4. Mokhtar S. Bazaraa , John J. Jarvis, Hanif D. Sherali  
Linear Programming and Network Flows.  
Wiley 2011.

### Who can apply?

B.E / B.Tech. (any discipline)

### Pre-requisites:

Elementary Linear Algebra

**Course Fee:** Rs. 10,000/-

**Schedule: Tuesday's** 6.00 pm - 8.00 pm

## 5. Business Analytics with Management Science Models and Methods (3+0)

### Objectives:

To provide business practitioners and those who are interested in Business Analytics a selected set of Management Science and optimization techniques along with the fundamental concepts, methods, and models needed to understand prescriptive-analytics and implement these techniques in the era of Big Data.

### Syllabus:

Introduction to Business Analytics, Linear/Integer/Non-Linear Optimization, Optimization of Network Models, Dynamic Programming, Heuristic Programming, Goal Programming, Multi-Attribute Decision Making Methods, and Monte Carlo Simulation. These are believed to be among the most popular Prescriptive Analytics tools to solve a majority of business optimization problems, with case studies from Business, Industry, and Government (BIG) applications using LINDO/LINGO/CPLEX optimization package

### Target Group:

Every Business, Industry and Government (BIG) organizations which has “Business Analytics’ group to address various problems associated with Prescriptive Analytics, In addition, all interested UG and PG Graduates in Engineering and Post Graduate in Business Administration/Management, Operations Research , Computer Science, Computer Applications, Mathematics, Statistics, Economics.



### Faculty:

**Dr. M Mathirajan**  
Chief Research Scientist,  
Dept. of M S.,  
Faculty of Engineering,  
IISc, Bengaluru.  
Email: [msdmathi@iisc.ac.in](mailto:msdmathi@iisc.ac.in);  
[drmuthu.mathirajan@gmail.com](mailto:drmuthu.mathirajan@gmail.com)

### Reference Books:

1. U Dinesh Kumar,  
Business Analytics: The Science of Data-Driven  
Decision Making, Wiley India, 2017.
2. William P Fox,  
Mathematical Modeling for Business Analytics,  
CRC Press. Taylor & Francis Group, LLC. 2018.
3. Abben Asllani,  
Business Analytics with Management Science Models  
and Methods. Person Education 2015.
4. Stephen G Powell and Kenneth R Baker,  
Business Analytics: The Art of Modelling with  
Spreadsheets. John Wiley & Sons. 2017.

### Who Can apply?

BE/B.Tech., ME/M.Tech. MBA, and Master in Operations  
Research, Computer Science, Computer Applications,  
Mathematics, Statistics, and Economics.

**Course Fee:** Rs. 15,000/-

**Schedule:** Tuesday & Thursday - 6.00 pm. to 7.30 pm.

## 6. Vibration & Noise: Theory & Practice (2+0)

### Objectives:

Growing awareness of vibration, noise and harshness feeling has necessitated the valid design criterion in the design of machines, automobiles, buildings, industrial facilities, etc, and the increasing number of standard regulations and human comfort associated with noise, harshness and vibration makes it mandatory to control vibration and noise leading to quieter technology in pumps, engines, compressors, chillers and other consumer products. There is a great demand to enhance ride comfort of bikes, cars, aircrafts and other automobiles. Vehicle Dynamics basics and growing awareness about noise pollution among the consumer necessitates the OEM companies to stress upon the products without NVH problems. Analytical, MATLAB and FEM based tools such as ANSYS, NASTRON, ABACUS and SYSNOISE helps to achieve the goals of NVH study. This course is for engineers/scientists/entrepreneurs/instructors in the industries/institutes to learn the analytical and experimental skills to tackle the problems related noise, vibration and harshness (NVH) during design and manufacturing stage for technically superior and commercially viable product to achieve “EMPOWER INDIA WITH SKILL AND Knowledge”

### Syllabus:

Vibration of structural systems. SDOF, 2-DOF, MDOF and continuous systems. Eigen values and vector estimation methods. Free and Forced vibration analysis. Torsional vibration and applications. Damping estimation methods

**Structural Vibration control elements:** isolation, damping, balancing, resonators, absorption, barriers and enclosures. Vibration and noise standards. NVH measurement tools and techniques. Modal parameter (natural frequency, mode shape and damping) estimation techniques. Signal and system analysis. **Demonstration of vibration and noise experiments** – beam, plates, impulse excitation, electrodynamic shaker excitation, FFT analyzer, stroboscope and mode shape animation, sound level meter, microphones. Vibration transfer function (VTF) and noise transfer function (NTF)

**Noise** and its effects on man. Acoustic and sound field. Enclosures, shields and barriers-design. Silencer and suppression systems. Noise level interpolation and mapping. Harshness effects and measurements and solutions. NVH Parameters related to vehicle dynamics

**Case studies discussion** (vibration reduction in passenger car, tiller, tractors, steering column/wheel vibration diagnosis, Modal analysis of Helicopter, Vibration diagnosis in diesel engine power plant, rotodynamic analysis of DWR and tracking antenna and engine and compressor noise attenuation and vibration isolation, engine-compressor mount design, vibration diagnosis in power plants, gear shift harshness, newspaper printing cylinder vibration diagnosis, engine filter bracket dynamic analysis, noise reduction for mixer grinders, field audit of industrial chimney for wind induced vibration, stability studies of sports bike, aerodynamic stability derivatives of scaled model of aerospace vehicles)

### Target Group:

Mechanical, Civil, Aerospace, Automotive, Industrial Engineers, Construction Technologists, R & D Labs, New product Design and Development Groups, Entrepreneurs and Engineering College Instructors. Professionals to pursue Postgraduate and Higher Studies



### Faculty:

**Dr. S B Kandagal**

Principal Research Scientist,

Dept. of AE.,

IISc., Bengaluru.

Email: [ksb@iisc.ac.in](mailto:ksb@iisc.ac.in)

### Reference Books:

1. Harris, C.W”,  
Shock and Vibration Handbook”  
McGraw Hill, New York, 2012.
2. Ewins, D.J.  
” Modal analysis: Theory and Practice”,  
Research Studies Press Ltd, England, 2014
3. Gillespie, T.D.,  
“Fundamentals of Vehicle Dynamics”,  
Society of Automotive Engineers. Inc, 2010.
4. Beranek, L.L,  
” Noise and Vibration Control”, Wiley, 2008

### Who Can apply?

B.E / ME / MSc./ AMIE OR equivalent

**Course Fee:** Rs. 10,000/-

**Schedule:** Wednesday's - 6.00 pm. to 8.00 pm.

## 7. Analysis & Design of Composite Structures (2+0)

### Objectives:

"Composites are future materials which are finding applications in all fields of Engineering. Many FEM software packages are available for Analysis & Design. One should first understand the Mechanical behavior of the Composite Structures before using FEM packages for better quality of professional work and optimum usage of time, computing and human resources. This course helps in understanding the Mechanical behavior of the Composite Structures.

### Syllabus:

**Introduction:** Basic Concepts and Terminology, different types of fibers and matrices, their properties and applications.

**Micromechanics of Composites:** Prediction of properties,

**Macromechanics of Lamina:** The theory of elasticity, Constitutive equations of a lamina, transformations, numerical examples.

**Failure theories** for composite lamina, numerical examples.

**Mechanics of Laminated Composites:** ABD matrices, numerical examples. **Hygrothermal Analysis**, numericals.

**Bending Analysis of Beams**, numerical examples.

**Analysis of Laminated composite plates:** Classical and first order theories, Energy Method, numerical examples.

**Buckling analysis of plates**, numerical examples.

**Design of laminates** using Carpet plots, AML plots and numerical examples on design of composite laminates.

### Target Group:

1. Faculty/Technologists/ Engineers/ Scientists/ Trainees/ Project Staff/ etc. from Industries, R & D Organizations, Institutions, Colleges etc.
2. Fresh Graduates, Post Graduates, Ph.D. Students, Research Fellows, SRFs, JRFs, Project Associates, Project Assistants etc.



### Faculty:

**Dr. G. Narayana Naik**  
Principal Research Scientist,  
Dept. of AE.,  
IISc., Bengaluru.  
Email: [gnn@iisc.ac.in](mailto:gnn@iisc.ac.in)

### Reference Books:

1. Robert M. Jones,  
Mechanics of Composite Materials: Second Edition,  
McGRAW-Hill Kogakusha, Ltd. – Year 1999.
2. J.N.Reddy,  
Mechanics of Laminated Composite Plates and Shells  
Theory and Analysis – CRC Press – 2004.
3. Madhujit Mukhopadhyay,  
Mechanics of Composite Materials and Structures-  
Universities Press- Engg. 2004.

### Who Can apply?

B.E / B.Tech. / AMIE / M.Sc.(Engg.)/ AMAeSI (Engg.)  
(Mechanical, Aero, Civil, etc) OR equivalent

**Course Fee:** Rs. 10,000/-

**Schedule:** Thursday's - 6.00 pm. to 8.00 pm.



## 8. Introduction To Numerical Methods for Fluid Flow Computations (2+0)

### Objective:

To impart basic knowledge in fluid dynamics, and numerical methods used in computational fluid dynamics to a beginner. CFD has become a very important tool in design and analysis. It is necessary to understand the basic concepts of Mesh generation, governing equations of fluid dynamics and numerical methods. To impart certain CFD expertise to a practicing CFD Engineer in an industry.

### Syllabus:

Introduction and Relevance of CFD, Governing equations of fluid dynamics and their various levels of approximations; Behaviour of Partial Differential Equations (PDE). Introduction to discretization, Various numerical techniques, FDM and FVM. Time Marching and space Marching methods. Introduction to geometrical aspects of simple and complex bodies; Grid/Mesh Generation Methods; Algebraic, PDE based Mesh Generations with examples.

### Target Group:

Engineering College Teachers, Engineers in R&D of Industries



### Faculty:

**Dr. P S Kulkarni (Retd.)**

Computational Mechanics Lab,  
Dept. of Aerospace Engineering/ JATP, IISc,  
E-mail: [psk@iisc.ac.in](mailto:psk@iisc.ac.in) /

### Reference Books:

1. Joe F Thompson, Z.U.A. Warsi & Wayne C  
Numerical Grid Generation: Foundations &  
Applications, North Holland, 1985.
2. John D Anderson, Jr  
Weatherhill N P Grid Generation  
Computational Fluid Dynamics: The basics with  
Applications, Mc Graw-Hill, Inc., International  
Edition, 1995.

### Who can apply?

B.E./M.Sc. (Phy, Maths)

**Course Fee:** Rs. 10,000/-

**Schedule:** Thursday's - 6.00 pm. to 8.00 pm.

## 9. Mathematics for Data Science (2+0)

### Objective

To Prepare Students in mathematical concepts required for studying data science.

### Syllabus:

**Basics of Calculus** – limits, derivative, derivative of basic functions, function of a function, product rule, functions of multiple variables – partial derivatives; maxima and minima, geometrical and physical interpretation of derivatives.




Integration – indefinite integral, methods of integration – product rule and integration by substitution; definite integrals, integral as area under a curve, some simple applications – finding area and volume; integration of functions of multiple variables, introduction to differential equations and partial differential equations.

**Linear algebra** – Vectors and matrices, rank of a matrix, transpose of a matrix, determinant of a matrix, Matrix multiplication – inner and outer products; inverse of a matrix, methods to find the inverse of a matrix, Eigen values and Eigen vectors, dimensionality reduction – Principle Component Analysis (PCA).

**Probability Theory** – sample and event space, axioms of probability, mutually exclusive events, conditional probability and Bayes' theorem, independence, concept of random variables, discrete and continuous random variables, distribution and density functions, some standard discrete and continuous distributions, moments, sampling and sampling distributions, hypothesis testing, multivariate distributions.

Basic concepts of stochastic processes, stationary process, introduction to Markov process.

**Target Group:** Any Industries that deal with data analysis and management and academics interested in data science.

	<p><b>Faculty</b>  <b>Dr. Gopal Krishna Sharma</b>  Fiserv India Pvt. Ltd.,  Bengaluru.  Email : <a href="mailto:gopalaks@yahoo.com">gopalaks@yahoo.com</a></p>		<p><b>Faculty</b>  <b>Dr. Badarinath Ambati</b>  Altair Engineering,  Bengaluru.  Email : <a href="mailto:abadarinath@yahoo.com">abadarinath@yahoo.com</a></p>		<p><b>Faculty</b>  <b>Prof. Muddu Sekhar</b>  Dept. of Civil Engineering,  IISc., Bengaluru.  Email : <a href="mailto:madhu@iisc.ac.in">madhu@iisc.ac.in</a></p>
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Publications.</li> <li>2. Kishor Trivedi Probability and Statistics with Reliability, Queuing and Computer Science Applications. Wiley Publications.</li> </ol>		<p style="text-align: center;"><b>Who Can apply?</b></p> <p style="text-align: center;">Any Engineering Degree with Mathematics</p> <p style="text-align: center;"><b>Course Fee:</b> Rs. 10,000/-</p> <p style="text-align: center;"><b>Schedule:</b> Thursday's: 6.00 pm. to 8.00 pm</p>			

## 10. Deep Learning: Theory and Practice (2+0)

### Objectives:

Understanding the Theory and Background of Deep Learning Approach to Artificial Intelligence. Applying Deep Learning Methods to Solve Problems in Audio, Image and Text Data.

### Syllabus:

Basics of Pattern Recognition, Neural Networks. Introduction to Deep Learning Convolutional Networks and Recurrent Neural Networks. Applications in Audio, Image and Text. Theory in Class and Coding Assignments.

### Target Group:

Academia, Govt. R&D and Industry Personnel Working/Interested in Artificial Intelligence.



### Faculty:

**Dr. Sriram Ganapathy**

Asst. Prof.,

Dept. of EE.,

IISc., Bengaluru.

E-mail: [sriramg@iisc.ac.in](mailto:sriramg@iisc.ac.in)

### Reference Books:

1. Christopher M. Bishop,  
“Pattern Recognition and Machine Learning”.  
2<sup>nd</sup> Edition. Springer, 2007.
2. Christopher M. Bishop,  
“Neural Networks”. 2<sup>nd</sup> Edition, Springer, 1995
3. Ian Goodfellow, Yoshua Bengio & Aaron Courville,  
“Deep Learning”, MIT Press, 2016. [html](#).

### Who can apply?

Bachelor of Technology in Electrical, Computer, Electronics Engineering Information Technology or related areas. (Contact the Course Supervisor for any Exceptions).

### Pre-requisites:

Basic Calculus, Probability and Linear Algebra

**Course Fee:** Rs. 10,000/

**Schedule:** Thursday's 6.00 pm - 8.00 pm

## 11. Online Course on Deep Learning: Theory and Practice (2+L)

### Objectives:

Understanding the Theory and Background of Deep Learning Approach to Artificial Intelligence. Applying Deep Learning Methods to Solve Problems in Audio, Image and Text Data.

### Syllabus:

Basics of Pattern Recognition, Neural Networks. Introduction to Deep Learning Convolutional Networks and Recurrent Neural Networks. Applications in Audio, Image and Text. Theory in Class and Coding Assignments.

### Target Group:

Academia, Govt. R&D and Industry Personnel Working/Interested in Artificial Intelligence.



### Faculty:

**Dr. Sriram Ganapathy**

Asst. Prof.,

Dept. of EE.,

IISc., Bengaluru.

E-mail: [sriramg@iisc.ac.in](mailto:sriramg@iisc.ac.in)

### Reference Books:

1. Christopher M. Bishop,  
“Pattern Recognition and Machine Learning”.  
2<sup>nd</sup> Edition. Springer, 2007.
2. Christopher M. Bishop,  
“Neural Networks”. 2<sup>nd</sup> Edition, Springer, 1995
3. Ian Goodfellow, Yoshua Bengio & Aaron Courville,  
“Deep Learning”, MIT Press, 2016. [html](#).

### Who can apply?

Bachelor of Technology in Electrical, Computer, Electronics Engineering Information Technology or related areas. (Contact the Course Supervisor for any Exceptions).

### Pre-requisites:

Basic Calculus, Probability and Linear Algebra

**Course Fee:** Rs. 15,000/

**Schedule:** Thursday's 6.00 pm - 8.00 pm

## 12. Introduction to Robotics (2+0)

### Objectives:

Introduction to Robotics and Current Trends /Development.

Discuss Fundamentals & Techniques in Design, (Techniques) and Analysis of Robots & their motion in 3D Space.

### Syllabus:

1. Introduction to Robotics
2. Spatial Transformations
3. Forward & Inverse Kinematics
4. Jacobian & Singularities
5. Robotic Dynamics
6. Robot Control
7. Robot Path Planning and Programming.

### Case Studies

### Target Group:

Industry / R&D Units / Post Graduation.



### Faculty:

**Dr. Abhra Roy Chowdhury**

Assistant Professor,  
(Robotics and Automation)  
CPDM., IISc., Bengaluru.  
E-mail: [abhra@iisc.ac.in](mailto:abhra@iisc.ac.in)

### Reference Books:

1. Sciavicco, L and Siciliano, B  
Modeling and Control of Robot Manipulators 2<sup>nd</sup>  
Edition, (Springer Verlag, London, 2000.
2. Mark W. Spong and M Vidyasagar  
Robot Dynamics and Control,  
Wiley, Newyork, 2008.
3. Ashitava Ghosal  
Robotics: Fundamentals, Concepts & Analysis,  
Oxford (IISc.) 2006.

### Who can apply?

B.E, B.Tech., ME, M.Tech., MCA, MSc.

### Pre-requisites:

Basic Knowledge of Mathematics (Algebra, & Geometry),  
Physics & Computer Programming.

**Course Fee:** Rs. 10,000/-

**Schedule:** Thursday's 6.00 pm - 8.00 pm

## 13. Structural Analysis and Design Optimization: Theory and Practice (2+0)

### Objectives:

Advanced research in material science to enhance the life with reduced cost resulted in metal alloys, plastics, composites and nano materials. Structural design and optimization of components with unusual shapes became possible with current available finite element software tools such as ANSYS, NISA, NASTRON, ABACUS, SYSNOISE, LSDYNA and MATLAB etc. The fundamental knowledge of stress, strain, shear, torsion in relation to the structures and S-N curves in relation to the material fatigue life becomes important. The interpretation of the FEM software output calls for the knowledge of analysis and design optimization of mechanical systems. This course essentially trains engineers/scientists/entrepreneurs/instructors in the industries/institutes to optimally design various mechanical systems and sub-systems for technically superior and commercially viable value added product and achieve “EMPOWER INDIA WITH SKILL AND Knowledge”

### Syllabus:

Applied mechanics, Strength of materials, SFD, BMD, AFD, solid mechanics, concept of stress, strain and fatigue. Constitutive laws. Mohr's Circle, Engineering materials and their properties. Structural analysis concepts, tension, compression, shear, torsion, coupled system, and S-N curves. Design of beams, torsion, compression members and fasteners. Stability of structures. Composite materials and their importance in structural analysis design optimization.

Principles of optimization, formulation of objective function and design constraints, classification of optimization problem. Single and multivariable optimization. Optimization with equality and inequality constraints.

Optimal design of mechanical elements – fasteners, springs, gears, bearings, belts, clutches, brakes, shafts and axles. Procedures for product design, development and testing. Vibration of structures

Practical problem discussion with industrial products

(optimization of passenger car sub systems for vibration and noise reduction, Rail-coach-CBC couplers, Car door window regulator, satellite tracking antenna and DWR antenna design, Tractor canopy, hydraulic crawler driller (drilling machine), Bike brake system, sluice valve design, failure analysis of piston drill bit, thermally insulated box, IP turbine blade failure analysis, design analysis of super pump impeller, Structural design aspects in power plants. Hydraulic jacks/Feed cylinder with intermediate supports, Industrial chimney design, optimization of box culverts, metal-composite sprocket for bikes, design criteria for Van pump, Thermal analysis of heat exchangers, 6-DOF force balance, pitch flexure, roll flexure design for wind tunnel model studies for aerodynamic derivatives of aerospace vehicle and automobiles).

### Target Group:

Mechanical, Civil, Aerospace, Automotive, Industrial Engineers, R & D Labs, Construction Technologists, New product Design and Development Groups, Entrepreneurs and Engineering College Instructors. Professionals to pursue Postgraduate and Higher Studies



### Faculty:

**Dr. S B Kandagal**  
Principal Research Scientist,  
Dept of AE,  
IISc., Bengaluru.  
Email: [ksb@iisc.ac.in](mailto:ksb@iisc.ac.in)

### Reference Books

1. Beer F P and Johnson, E.R,  
“Vector Mechanics for Engineers- Statics and Dynamics”,  
Tata-Mac Graw Hill, Sixth Edition, 2012.
2. Shigley, J.E and Mischke, C.R.,  
“Mechanical Engineering Design”  
Tata-Mac Graw Hill, sixth Edition, 2010.
3. Johnson Ray, C.  
”Optimum Design of Mechanical Elements”,  
Wiley, John & Sons, 2014.

### Who Can apply?

BE, ME, MSc , AMIE, or equivalent

**Course Fee:** Rs. 10,000/-

**Schedule: Friday's** 6.00 pm. to 8.00 pm.

## 14. Project Management (2+0)

### Objective

This course is envisaged to develop the competences and skills for planning, scheduling and controlling projects. This course provides a systematic and through introduction to all aspects of project management.

Students explore project management with a practical, hands-on approach through case studies and class exercises.

The knowledge and skills gained in this course will help in Project Management Institute's (PM) Project Management Professional (PMP) Program.

### Syllabus:

- What is Project Management
- Organizing Project Management Office & Term
- Project Planning
  - Work Break Down Structure
- Project Budgeting
  - Cost Estimation
- Project Scheduling
  - Gantt Chart
  - PERT/CPM
- Project Resource Allocation
  - Fast Tracking-Crashing
  - Resource Loading & Leveling
- Project Management & Controlling
  - Earned Value
  - Scope Creep and Change Control
- Project Evaluation & Termination

### Target Group:

Practicing Engineers, Scientists, R&D Managers, Construction Managers, Architects, Designers, Professionals from knowledge & IT Industries, Entrepreneurs.



#### Faculty:

**Dr. J E Diwakar (Retd.)**  
CPDM.,  
IISc., Bengaluru.  
Email: [jed@iisc.ac.in](mailto:jed@iisc.ac.in)



#### Faculty:

**Prof. TVP Chowdry**  
Project Scientist,  
CST, IISc., Bengaluru.  
E mail: [tvpchowdry@gmail.com](mailto:tvpchowdry@gmail.com)

### Reference Books:

1. Meredith R Jack, Mantel J Samuel, Shafer M Scott, Sutton M Margaret and Gopalan M R,  
Project Management: Core Textbook, 1<sup>st</sup> Indian Edition, Wiley, 2006, ISBN 81-265-0949-6.
2. Project Management Institute, A Guide to the Project Management Body of Knowledge: (PMBOK® Guide) Sixth Edition, PMI, 2018, ISBN 9781628253825.
3. Chartered Management Institute, Successful Project Management, 2<sup>nd</sup> Edition Elsevier, 2004, ISBN 0-7506-64197.

### Who Can apply?

Graduation in Engineering//Architecture/Design or  
Post-Graduation in Management.

**Course Fee:** Rs. 10,000/-

**Schedule: Friday's :** 6.00 pm. to 8.00 pm

## 15. Pattern Recognition (2+0)

### Objectives:

All the essential components of a pattern recognition system will be examined. Both the theoretical and practical aspects will be covered in detail so that practitioners as well as researchers will be benefited.

### Syllabus:

Introduction to pattern recognition and machine learning. Representation of patterns, classes, and clusters. Classification: Nearest Neighbor based Bayesian and Naïve Bayes' classifiers, Decision-Tree classifier, SVMs, Clustering: Partitional and Hierarchical clustering Algorithms.

### Target Group:

Faculty/Engineers, Employees of any Industry/ R&D Unit dealing with Pattern Recognition.



### Faculty:

**Prof. M Narasimha Murty**

Dept. of CSA.,

IISc, Bengaluru.

Email: [mmm@iisc.ac.in](mailto:mmm@iisc.ac.in)

### Reference Books:

1. V. S. Devi and M. N. Murty,  
Pattern Recognition,  
Universities Press, 2011.
2. M. N. Murty and V. S. Devi,  
Introduction to Pattern Recognition and Machine  
Learning,  
World-Scientific, 2015.
3. R. O. Duda, P. E. Hart, and D. G. Stork,  
Pattern Classification,  
Wiley-Interscience, 2000

### Who can apply?

A good background in Mathematics at the BE/B.Tech level.

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's – 10.00 am. to 12.00 noon



## 16. Basics of Data Analytics (2+0)

### Objective

To introduce Data Analytics to a person new to the field and make him/her ready for advanced courses.

### Syllabus:

Introduction to Data Science, Review of Probability theory – Axioms of probability, mutually exclusive events, Conditional Probability and Bayes' theorem, Independence, Concept of Random Variables, discrete and continuous random variables, distribution and density functions, some standard discrete and continuous distributions, moments, statistics, mean and variance, unbiased estimates.

Bivariate data, Scatter plot, Trend, converting non-linear trend into a linear one, Co-variance and correlation coefficient, least square minimization of errors, residues and their properties, ANOVA, Hypothesis testing for the model and for parameters, confidence intervals.

Multivariate data, partial correlation coefficient, concept of dimensionality reduction, parameter estimation by minimizing the squared errors.

Smoothing techniques - moving averages and exponential smoothing.




Univariate data – Trend, Seasonality, Cyclicity, concept of stationarity, auto-correlation function (ACF) and partial autocorrelation function (PACF), making a series stationary, AR, MA and ARIMA models, estimation of p, d and q, estimation of model parameters, Akaike's information criteria and other goodness of fit metrics, seasonal ARIMA.

Overview of Machine Learning, Internet of Things, Neural Networks and associated topics.

Software development project using Python consisting of all the topics learnt.

### Target Group:

Any Industries that deal with data analysis and management and academics interested in data science.

	<p><b>Faculty</b> <b>Dr. Gopal Krishna Sharma</b> Fiserv India Ltd., Bengaluru. Email : <a href="mailto:gopalaks@yahoo.com">gopalaks@yahoo.com</a></p>		<p><b>Faculty</b> <b>Dr. Badarinath Ambati</b> Altair Engineering, Bengaluru. Email : <a href="mailto:abadarinath@yahoo.com">abadarinath@yahoo.com</a></p>		<p><b>Faculty</b> <b>Prof. Muddu Sekhar</b> Dept. of Civil Engineering, IISc., Bengaluru. Email : <a href="mailto:madhu@iisc.ac.in">madhu@iisc.ac.in</a></p>
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### Reference Books:

1. Spyros Makridakis et. al.  
Forecasting Methods and Applications  
Wiley, 2005.
2. Bovas Abraham and Johanna Lodolter  
Statistical Methods for forecasting  
Wiley, 1983.
3. Kishor S. Trivedi  
Probability and Statistics with Reliability,  
Queuing and Computer Science Applications.  
Wiley, 2002

### Who Can apply?

Any Engineering Degree with Mathematics Background

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's- 10.00 am. to 12.00 noon

## 17. Online Course on Basics of Data Analytics (2+L)

### Objective

To introduce Data Analytics to a person new to the field and make him/her ready for advanced courses.

### Syllabus:

Introduction to Data Science, Review of Probability theory – Axioms of probability, mutually exclusive events, Conditional Probability and Bayes' theorem, Independence, Concept of Random Variables, discrete and continuous random variables, distribution and density functions, some standard discrete and continuous distributions, moments, statistics, mean and variance, unbiased estimates.

Bivariate data, Scatter plot, Trend, converting non-linear trend into a linear one, Co-variance and correlation coefficient, least square minimization of errors, residues and their properties, ANOVA, Hypothesis testing for the model and for parameters, confidence intervals.

Multivariate data, partial correlation coefficient, concept of dimensionality reduction, parameter estimation by minimizing the squared errors.

Smoothing techniques - moving averages and exponential smoothing.




Univariate data – Trend, Seasonality, Cyclicity, concept of stationarity, auto-correlation function (ACF) and partial autocorrelation function (PACF), making a series stationary, AR, MA and ARIMA models, estimation of p, d and q, estimation of model parameters, Akaike's information criteria and other goodness of fit metrics, seasonal ARIMA.

Overview of Machine Learning, Internet of Things, Neural Networks and associated topics through student seminars.

Software development project using Python consisting of all the topics learnt.

### Target Group:

Any Industries that deal with data analysis and management and academics interested in data science.

	<p><b>Faculty</b> <b>Dr. Gopal Krishna Sharma</b> Fiserv India Ltd., Bengaluru. Email : <a href="mailto:gopalaks@yahoo.com">gopalaks@yahoo.com</a></p>		<p><b>Faculty</b> <b>Dr. Badarinath Ambati</b> Altair Engineering, Bengaluru. Email : <a href="mailto:abadarinath@yahoo.com">abadarinath@yahoo.com</a></p>		<p><b>Faculty</b> <b>Prof. Muddu Sekhar</b> Dept. of Civil Engineering, IISc., Bengaluru. Email : <a href="mailto:madhu@iisc.ac.in">madhu@iisc.ac.in</a></p>
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Spyros Makridakis et. al. Forecasting Methods and Applications Wiley, 2005.</li> <li>2. Bovas Abraham and Johanna Lodolter Statistical Methods for forecasting Wiley, 1983.</li> <li>3. Kishor S. Trivedi Probability and Statistics with Reliability, Queueing and Computer Science Applications. Wiley, 2002</li> </ol>			<p style="text-align: center;"><b>Who Can apply?</b></p> <p style="text-align: center;">Any Engineering Degree with Mathematics Background</p> <p style="text-align: center;"><b>Course Fee:</b> Rs. 15,000/-</p> <p style="text-align: center;"><b>Schedule:</b> Saturday's- 10.00 am. to 12.00 noon</p>		

## 18. Mathematical Foundations for Machine Learning (2+0)

### Objectives:

To provide Mathematical Foundations for Machine Learning Applications like Medical Imaging, Face Recognition, Object Recognition.

### Syllabus:

Unit 1. Linear Algebra: Vector Spaces, Subspaces Basics

Unit 2. Eigenvalues, Eigenvectors, Projection, Orthogonalization, GS Algorithm

Unit 3. Matrices, Matrix Factorization, LU, QR, SVD Solving Systems Equations

Unit 4. Machine Learning as a Pattern Recognition Problem, Design of Classifiers, Training and Testing

Unit 5. Subspace Methods in Machine Learning for the Face and Object Recognition.

### Target Group:

Samsung, Microsoft and Companies Working on Data Analytics & Machine Learning.



#### Faculty:

**Mr. M Krishna Kumar ( Retd.),**  
**PRS.,** Dept. of ESE (CEDT),  
 IISc., Bengaluru  
 Email. [mkkumarcedt@gmail.com](mailto:mkkumarcedt@gmail.com)



#### Faculty:

**Dr. Arulalan Rajan,**  
 Formerly, Assistant  
 Prof.,  
 Dept. of E& C Engg.,  
 NITK..., Surathkal..



#### Faculty:

**Dr. Ashok Rao,**  
 Formerly Head,  
 Networking Project,  
 Dept. of ESE (CEDT),  
 IISc., Bengaluru

### Reference Books:

1. Gilbert Strang,  
 "Introduction to Linear Algebra",  
 Wellesley Cambridge Press, 5<sup>th</sup> Ed.  
 2016.
2. Gilbert Strang,  
 "Linear Algebra and Learning from  
 Data", Wellesley Cambridge Press,  
 2019.
3. Christopher M Bishop,  
 "Pattern Recognition & Machine  
 Learning", Springer, 2016.

### Who can apply?

BE/B.Tech/ AMIE or equivalent.

**Pre- Requisites:** MATLAB Programming will be useful.

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's – 10.00 am to 12.00 noon

## 19. Nonlinear Finite Element Method (2+0)

### Objectives:

This is a second level course covering some advanced topics in Finite Element Analysis. In particular, focus would be on Concepts and techniques of Nonlinear Finite element Analysis in this course.

Nonlinear FEM techniques are usually not covered in the first course of FEM. The FEM treatment of Nonlinear problems requires additional background of the inelastic behavior of materials and nonlinear-mechanics for better understanding but, such options are generally not available to graduate engineers or even to post-graduates. However, practicing engineers, especially structural analysts and designers, usually come across many practical problems which require nonlinear finite element analysis. Most of the commercial packages do have nonlinear analysis facilities. However, even to use such packages a good understanding of Nonlinear Finite Element analysis techniques is required. The objective of this course is to introduce basic concept of nonlinear finite element analysis with reference to solid mechanics applications. Bucklings are included.

### Syllabus:

Review of linear FEM with reference to Isoparametric 2-D and 3-D Finite Elements. Concept of Material, Geometric and Contact Nonlinearities. Elements of Nonlinear Mechanics, Constitutive Relations using Plasticity. Finite-Deformation, Finite Element Formulation of Nonlinear problems in Solid Mechanics. General Solution Techniques, Computational Aspects and Application.



### Faculty:

**Prof. P. C. Pandey (Retd. IISc.)**

Emeritus Professor, Reva University,

E-mail: [profpcpandey@yahoo.com](mailto:profpcpandey@yahoo.com) /  
[pcpandey@alumni.iisc.ac.in](mailto:pcpandey@alumni.iisc.ac.in)

### Reference Books:

1. Cook, R. D., et.al, Concepts & Applications of Finite Element Analysis, John Wiley & Sons, 2002 (IV Ed)
2. Zienkiewicz, O. C., and Taylor, R. L., The Finite Element Method, V Edn., Vol 1 & 2, McGraw-Hill, 2002 (V Ed.).
3. Reddy, J. N. An Introduction to Nonlinear Finite Element Analysis, Oxford University Press Inc, Oxford, 2004.

### Who can apply?

BE/ B.Tech.  
(Civil/Mechanical/Aerospace), OR equivalent

### Pre-requisites:

Basic knowledge of Solid Mechanics. An Exposure to Basic Finite Element Method

**Course Fee:** Rs.10,000/-

**Schedule:** Saturday's – 10.00 am to 12.00 noon

## 20. Image Processing and Computer Vision (3+0)

### Objectives:

The course is ideally suited for those who wish to learn in depth about some of the core models and algorithms in image processing and computer vision. A part of the course will focus on Mathematical Preliminaries and introduce the participants to some of the classical computational models and algorithms. Also, we will look at some State-of-the-art technologies. The participants will be handed out assignments involving problem solving and coding (Open CV and Matlab).

### Syllabus:

Overview of image processing and computer vision; various computational models and algorithms; modern applications.

### Topics:

Sampling and quantization, Fourier and wavelet transforms, compression, statistical and sparse image models, linear and nonlinear filters, edge detection, segmentation, image restoration, compressed sensing, ML/deep learning techniques.

### Target Group:

Research Scholars, Teachers, Engineers, Scientists and Professionals.



### Faculty:

#### Dr. Kunal Narayan Chaudhury

Assistant Professor,  
Dept. of Electrical Engineering  
IISc., Bengaluru.  
Email: [kunal@iisc.ac.in](mailto:kunal@iisc.ac.in)

### Reference Books

1. R. Szeliski,  
Computer Vision: Algorithms and Applications,  
Springer, 2011.
2. S. Mallat.  
A Wavelet Tour of Signal Processing.  
Academic Press, 1999.
3. Lecture notes provided by the instructor.

### Who Can apply?

BE/B.Tech.

### Pre-requisites:

Working Knowledge of calculus, linear algebra, and Probability.

**Course Fee:** Rs. 15,000/-

**Schedule:** Saturday's - 10.00 am. to 1.00 pm.

## 21. Reinforcement Learning (3+0)

### Objectives:

Teach Students about this emerging field of Reinforcement Learning because of its wide applicability.

### Syllabus:

Introduction to Reinforcement learning, Multi-armed bandits, Finite Markov decision processes, Dynamic Programming, Monte-Carlo Methods, Temporal difference methods, on-policy prediction and control.

### Target Group:

All People interested in Artificial Intelligence in Industry as well as Academia should find the course useful.



### Faculty:

**Prof. Shalabh Bhatnagar**  
Chairman, Dept. of CSA, IISc.  
E-mail: [shalabh@iisc.ac.in](mailto:shalabh@iisc.ac.in)

### Reference Books

1. R. S. Sutton and A. G. Barto  
Reinforcement learning: An Introduction,  
MIT Press, 2018
2. D. P. Bertsekas and J. N. Tsitsiklis  
Neuro-Dynamic Programming, 1996

### Who can apply?

BE, B.Tech., MCA

**Course Fee:** Rs. 15,000/-

**Schedule:** Saturday's 10 am to 1 pm

## 22. Online Course on Reinforcement Learning (3+L)

### Objectives:

Teach Students about this emerging field of Reinforcement Learning because of its wide applicability.

### Syllabus:

Introduction to Reinforcement learning, Multi-armed bandits, Finite Markov decision processes, Dynamic Programming, Monte-Carlo Methods, Temporal difference methods, on-policy prediction and control.

### Target Group:

All People interested in Artificial Intelligence in Industry as well as Academia should find the course useful.



### Faculty:

**Prof. Shalabh Bhatnagar**  
Chairman, Dept. of CSA, IISc.  
E-mail: [shalabh@iisc.ac.in](mailto:shalabh@iisc.ac.in)

### Reference Books

3. R. S. Sutton and A. G. Barto  
Reinforcement learning: An Introduction,  
MIT Press, 2018
4. D. P. Bertsekas and J. N. Tsitsiklis  
Neuro-Dynamic Programming, 1996

### Who can apply?

BE, B.Tech., MCA

**Course Fee:** Rs. 20,000/-

**Schedule:** Saturday's 10 am to 1 pm

## 23. Start-up Tools (SuT) (3+0)

### Objectives:

The aim of this Course is to introduce aspirants to the broad subject of Start-up Initiatives. “Start-up” is the buzz word being sprouting now and has a great potential to grow into a big woods in near future. The world at large appears to be tilted towards micro adventures called “Start-ups”. The course envisages imparting various skill sets – breeding IP culture, creation of IP and related aspects, seeking/ funds, management skills to handle stress to sustain business; effective Communication, sharing live Experience from founders of start-ups.

### Syllabus:

The Course aims to expose the students to the basic principles and practices in the broad field of “Start-up Ventures”: IP and IP protection; formalities of registration, compliances, seeking funding; Communication in general and technical writing in particular, and so on. It also aims to equip them with the knowledge, skills, and attitude they need to overcome problems in the creation and sustaining of a Start-up. It is planned to invite founders of Start-ups to relate their own experiences.

### Target Group:

All entrepreneurs, as well as students, engineers, and scientists, who aspire to kindle the “entrepreneur inside”

	<b>Faculty:</b>  <b>Dr. R.N. Narahari</b> CeNSE IISc., Bengaluru. Email: <a href="mailto:naraharir@iisc.ac.in">naraharir@iisc.ac.in</a>		<b>Faculty:</b>  <b>Prof. S A Shivashankar</b> (Professor Emeritus), CeNSE., IISc., Bengaluru Email: <a href="mailto:shiv@iisc.ac.in">shiv@iisc.ac.in</a>		<b>Faculty:</b>  <b>Dr. Sukhenddu Deb Roy</b> CeNSE., IISc., Bengaluru Email: <a href="mailto:sukhendudr@iisc.ac.in">sukhendudr@iisc.ac.in</a>
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### Reference Books

1. John Mullins  
“The New Business Road Test: What Entrepreneurs and Investors should do before Launching a Lean Start-up”; Person India Education Services PL, Noida, 2019.
2. Prof.Nandini Vaidyanatha  
“Entrepedia: A step-by-step guide to becoming an Entrepreneur in India”, 2<sup>nd</sup> Edition, Embassy Books, 2018.
3. Taraporevala, V J  
“Law of Intellectual Property”, Published by Taraporevala. V J, Mumbai, 2005.
4. William Strunk Jr & EB White.,  
“The Elements of Style”, Longman Publishers, MA 02494, USA.

### Who Can apply?

Those with BE/B.Tech. or Post-graduate Degree in Science/Engineering/Commerce

**Course Fee:** Rs. 15,000/-

**Schedule: Saturday's - 10.00 am. to 1.00 pm.**



## 24. Strategic Management (3+0)

### Objectives:

To Expose the Present day executives to the nuances of Strategic Management which is the most sought offer.

### Syllabus:

Strategic Management Process; Challenge of Globalization; Strategic Planning in India; 7 S Framework; Corporate Governance; Board of Directors; Role and Functions of top Management; Environmental Landscape Analysis; Strategic Formulation; Strategic Enablers.

### Target Group:

Industry -R&D Units; Educational Institutions with Management Programm.



### Faculty:

**Prof. R.Srinivasan**

Emeritus Professor,

Dept. of MS.,

IISc., Bengaluru.

Email: [sri@iisc.ac.in](mailto:sri@iisc.ac.in); [sri0192@gmail.com](mailto:sri0192@gmail.com)

### Reference Books:

1. R. Srinivasan,  
Strategic Management – The Indian Context,  
Prentice Hall of India, 5<sup>th</sup> Edition, 2014.
2. R. Srinivasan,  
Case Studies in Marketing – The Indian Context,  
Prentice Hall of India, 6<sup>th</sup> Edition, 2014.

### Who can apply?

Executing with Engineering Degree

**Course Fee:** Rs.15,000/-

**Schedule: Saturday's** - 10.00 am to 1.00 pm

## 25. Introduction to Industrial Design (3+0)

### Objective

“Industrial Design” is one of the youngest professions gaining recognition as a differentiator to survive and grow in the competitive global market. Professional Industrial Designers are in great demand in all sectors of industry today. Graduate and postgraduate courses are offered in India and abroad on Industrial Design and allied fields. In this Course, the Students are Introduced to what Industrial Designers do, how they contribute to be innovative and create great products. Industrial Designers bring new perspectives based on understanding of the users’ real needs and the context in which they use the products, and help develop products which meet users’ aspirations and contribute for the improvement of quality of life. They follow a proven process to identify opportunities and develop concepts to meet the challenges.

The students will learn about the history of design, design methodology, product ergonomics, developing successful products through lectures, discussions. The students are expected to do a lot of exercises in the classes and at home to get a good understanding of the topics. Ability in free hand sketching is necessary.

### Syllabus:

- Innovation, Creativity, Embedded Mindset to Creative Thinking. Barriers to Creativity.
- History of Design
- Industrial Design-Yesterday, Today and Tomorrow.
- Design Communication
- Product Design Process/ Methodology
- Elements of Design
- Principles of Design
- Product Ergonomics

### Target Group:

Practicing Engineers, Managers Responsible for developing engineering services, Professional in Design and Development in Industries, R & D Organizations etc., Academic Personal in teaching/practicing Product design/Service design, Product engineering, Design and Development and fresh engineers interested in Design and Innovation; Start up entrepreneurs



#### Faculty:

**Dr. J. E. Diwakar (Retd.)**  
Dept. of CPDM.,  
IISc., Bengaluru.  
Email: [jed@iisc.ac.in](mailto:jed@iisc.ac.in)



#### Faculty:

**Prof. P. Achutha Rao (Retd.)**  
NID R & D Campus.  
E Mail:  
[raopanambur@gmail.com](mailto:raopanambur@gmail.com)



#### Faculty:

**Prof. TVP Chowdry**  
Project Scientist CST  
E mail:  
[tvpchowdry@gmail.com](mailto:tvpchowdry@gmail.com)

### Reference Books:

1. Scott Hurff,  
Designing Products People Love; How Great Designers  
Create Successful Product, O'Reilly Media, 1<sup>st</sup> Edition, 2016.
2. Tom Peters,  
Design, Essential (DK Publishing) Paperback – 2005.
3. Richard Morris.  
The Fundamentals of Product Design 2<sup>nd</sup> Edition,  
Fairchild Books; 2016.
4. Charilotte & Peter Fiell,  
Industrial Design A-Z, Taschen 2016.
5. Carma Gorman,  
The Industrial Design Reader, All worth Press, 2003

### Who Can apply?

Graduation in Engineering/Management with a flair for  
arts and free hand sketching.

**Course Fee:** Rs. 15,000/-

**Schedule: Saturday's:** 1.00 pm. to 4.00 pm

## 26. Power System Protection (3+0)

### Objectives:

To Teach Power System Protection .Theories Relevant to Teachers, Researchers and Industry People.

### Syllabus:

Philosophies of Power System Protection; Fault Analysis, CTQ CVT Impacts on Protection; Overcurrent, Directional, Distance, Protection; Transmission Line Protection; Bus Protection, Transformer Protection, Generator Protection; IEC 61850; Special Protection Schemes.

### Target Group:

Academic Institutions; Industries; Research Labs.



### Faculty:

**Dr.Sarasij Das**  
Assistant Professor,  
Dept of EE,  
IISc., Bengaluru.  
Email:sarasij@iisc.ac.in

### Reference Books

1. Arun G Phadke & S H Horowitz  
“Power System Relaying”
2. C Christopoulos  
“Electrical Power System Protection”
3. IEEE C7 Series.

### Who Can apply?

BE, B.Tech.,

**Pre-requisites :** Basic Knowledge in Power Systems

**Course Fee:** Rs. 15,000/-

**Schedule: Saturday's:** 1.00 pm. to 4.00 pm.

## 27. Deep Reinforcement Learning (2+0)

### Objectives:

Deep RL is a Combination of RL and Deep Learning. This area has become hot because of the wide range of Complex Decision Making tasks that area now showable. The course will provide introduction to Deep RL, Models, and Technologies.

### Syllabus:

Introduction, Machine Learning and Deep Learning, Introduction to Reinforcement Learning, Value based Methods for Deep RL, Policy Gradients for Deep RL, Model based Methods, Generalization bench making Deep RL, Deep RL beyond MAPs, on Deep RL.

### Target Group:

Industry Professionals, College Teachers, Project Assistants Etc.



### Faculty:

**Prof. Shalabh Bhatnagar**  
Chairman, Dept. of CSA, IISc.  
E-mail: [shalabh@iisc.ac.in](mailto:shalabh@iisc.ac.in)

### Reference Books

1. V. François-Lavet, P. Henderson, R. Islam, M. G. Bellemare & J. Pineau  
An Introduction to Deep Reinforcement Learning, Foundations and Trends® in Machine Learning,  
Now Publishes, Boston, 2018.
2. Selected Research Papers.

### Who can apply?

BE, B.Tech., MSc., MCA

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's 2 pm to 4 pm

## 28. Online Course on Deep Reinforcement Learning (2+L)

### Objectives:

Deep RL is a Combination of RL and Deep Learning. This area has become hot because of the wide range of Complex Decision Making tasks that area now showable. The course will provide introduction to Deep RL, Models, and Technologies.

### Syllabus:

Introduction, Machine Learning and Deep Learning, Introduction to Reinforcement Learning, Value based Methods for Deep RL, Policy Gradients for Deep RL, Model based Methods, Generalization bench making Deep RL, Deep RL beyond MAPs, on Deep RL.

### Target Group:

Industry Professionals, College Teachers, Project Assistants Etc.



### Faculty:

**Prof. Shalabh Bhatnagar**  
Chairman, Dept. of CSA, IISc.  
E-mail: [shalabh@iisc.ac.in](mailto:shalabh@iisc.ac.in)

### Reference Books

3. V. François-Lavet, P. Henderson, R. Islam, M. G. Bellemare & J. Pineau  
An Introduction to Deep Reinforcement Learning, Foundations and Trends® in Machine Learning,  
Now Publishes, Boston, 2018.
4. Selected Research Papers.

### Who can apply?

BE, B.Tech., MSc., MCA

**Course Fee:** Rs. 15,000/-

**Schedule:** Saturday's 2 pm to 4 pm

## 29. Classical and Mathematical Physics (2+0)

### Objectives:

The course is Designed to Refresh the Basics of Classical and Mathematical Knowledge and Tools used in all Branches of Science and Technology.

### Syllabus:

**Classical Physics:** (i) Equation of Motion (ii) Least Action Method (iii) Symmetry and Conservation Laws (iv) Lagrangian Tharani Hamiltonian and Poisson Bracket Methods.

**Math Physics:** (i) Matic (ii) Differential Equations (iii) Complex Analysis.

### Target Group:

The topics of the courses are useful for Scientists, Technicians and Engineer of all Branches.



### Faculty:

**Dr. Tanmoy Das**

Assistant Professor,  
Dept. of Physics, IISc.

E-mail: [tnmydas@iisc.ac.in](mailto:tnmydas@iisc.ac.in)

### Reference Books

1. Landau & Lifshitz  
Classical Mechanics
2. Goldstein  
  
Classical Mechanics
3. George B Arfken  
  
Mathematical Methods for Physicists

### Who can apply?

Post Graduates

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's 2 pm to 4 pm

## 30. Basic Concepts of Finite Element Method (2+0)

### Objectives:

This is a foundation course in Finite Element Method (FEM) aimed at Civil, Mechanical and Aerospace Engineering professionals. In particular, it would be beneficial to engineers who do not have any formal training in FEM, even though; they may have skill to use a FEM package. The course is designed to provide a basic introduction to FEM with emphasis on stress and structural analysis. It is believed that it would be of interest to engineers working in industries, consulting firms and teachers of engineering colleges.

### Syllabus:

Concept of Stiffness and Flexibility in structural analysis. Basic foundations of elasticity and energy principles. Introduction to displacement based FEM with reference to continuum and skeletal structures. Element formulation and Applications to Plane stress, Plane strain, Axisymmetric and 3-D problems. Isoparametric concept, equation solvers, Post-processing. Adaptivity, Programming and Computational aspects as well as practical applications would be discussed.



### Faculty:

**Prof. P. C. Pandey (Retd. IISc.)**

Emeritus Professor, Reva University,

E-mail: [profpcpandey@yahoo.com](mailto:profpcpandey@yahoo.com) /  
[pcpandey@alumni.iisc.ac.in](mailto:pcpandey@alumni.iisc.ac.in)

### Reference Books:

1. Logan Daryl L A first Course in Finite Element Method Thomson, 5<sup>th</sup> Edition 2012.
2. Chandrupatala, T.R. and Belegundu A.D. Introduction to Finite Elements in Engineering, Prentice Hall – Indian Edition, III Ed, Aug 2003.
3. Cook, R.D. et.all Concept and Applications of Finite Element Analysis, John Wiley Sons, 2002. (IV Edition)

### Who can apply?

BE/ B.Tech.

(Civil/Mechanical/Aerospace), OR equivalent

**Course Fee:** Rs.10,000/-

### Schedule:

**Saturday's** -2.00 PM to 4.00 PM

## 31. Basics of Machine Learning (2+0)

### Objective

To introduce concepts of Machine Learning and prepare him/her for advanced courses.

### Syllabus:

Review of Probability theory, Axioms of probability, mutually exclusive events, Conditional probability and Bayes' theorem, Independence, concept of Random Variables, discrete and continuous random variables, distribution and density functions, some standard discrete and continuous distributions, moments Statistics, mean and variance, unbiased estimates.

Review of Linear Algebra- Vectors and matrices, rank of a matrix, transpose of a matrix, determinant of a matrix, Matrix multiplication-inner and outer products; inverse of a matrix, Eigen values and Eigen vectors.

Definition of Machine learning, supervised and unsupervised machine learning, Classification and Regression, learning multiple classes, Dimensionality reduction - Principal component analysis. Clustering, Decision Trees, Linear Discriminant, introduction to Neural Networks, perceptron, Learning Boolean functions, multi-layer perceptron, training a neural network for pattern recognition, Back propagation, Naïve Bayes' classifier, Hidden Markov Model.

Software development project using Python consisting of all the topics learnt.

### Target Group:

Any Industries that deal with data analysis and management and academics interested in data science.

	<b>Faculty</b> <b>Dr. Gopal Krishna Sharma</b> Fiserv India Pvt. Ltd., Bengaluru. Email : <a href="mailto:gopalaks@yahoo.com">gopalaks@yahoo.com</a>		<b>Faculty</b> <b>Dr. Badarinath Ambati</b> Altair Engineering, Bengaluru. Email : <a href="mailto:abadarinath@yahoo.com">abadarinath@yahoo.com</a>		<b>Faculty</b> <b>Prof. Muddu Sekhar</b> Dept. of Civil Engineering, IISc., Bengaluru. Email : <a href="mailto:madhu@iisc.ac.in">madhu@iisc.ac.in</a>
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### Reference Books:

1. Ethem Alpaydin,  
Introduction to Machine Learning,  
  
MIT Press, 2010.
2. Laurene V Fausett  
Fundamentals of Neural Networks  
Pearson Education
3. Kishor Trivedi  
Probability and Statistics with Reliability,  
Queuing and Computer Science Applications.  
John Wiley Sons, 2002.

### Who Can apply?

Any Engineering Degree with Mathematics Background

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's: 2.00 pm. to 4.00 pm



## 32. Probability Foundations for Machine Learning (2+0)

### Objectives:

This course aims to provide an in Depth Understanding of Probability Concepts for Engineers and Professionals Working in Various Domains Including Machines Learning, Data Science.

### Syllabus:

Probability and Counting, Conditional Probability Independence of events, Discrete and Continuous Random Variables and their Distributions, Independence of Random Variables, Joint Distributions Expectations Variance Moments, Conditional Expectations, Limit Theorems

Parameter Estimation and Estimation Techniques - Regression Models, Bayesian Methods.

Random Processes, Markov Chains – Bernoulli and Poisson Processes, Some Applications.

### Target Group:

Engineers and Researchers.



#### Faculty:

**Prof. R. Vittal Rao ( Retd.),**  
Dept. of Maths.,  
IISc., Bengaluru  
Email.: [Vittalrao.14@gmail.com](mailto:Vittalrao.14@gmail.com)



#### Faculty:

**Dr. Arulalan Rajan,**  
Formerly  
Assistant Prof.,  
Dept. of E& C Engg.,  
NITK., Surathkal..



#### Faculty:

**Dr. Ashok Rao,**  
Formerly Head,  
Networking Project,  
Dept. of ESE (CEDT),  
IISc., Bengaluru

### Reference Books:

1. Bertsekas, Tsitsiklis  
Introduction to Probability 2<sup>nd</sup> Ed.  
Athena Scientific.
2. Roy D Yates, D J Goodman  
Probability and Stochastic Processes,  
John Wiley.
3. Steven M Kay  
Intuitive Provability and Random  
Processes, Springer.

### Who can apply?

BE/ MSc.

**Pre-requisites :** Mathematics Graduate Level

**Course Fee:** Rs. 10,000/-

**Schedule:** Saturday's -2.00 pm - 4.00 pm.

## Appendix 'A' PROFORMA

### NAME OF THE COLLEGE

### PROVISIONAL CERTIFICATE

This is to certify that Sri/ Smt. .... was a student of this college studying in .....\*

Course .....\*\*

Branch during the Session ..... to .....

He / She have Successfully Completed the course as prescribed by the .....

University with regard to course of study, attendance, sessional requirements etc.

He / She has passed the final .....\* examination held during ..... securing .....class as per the results announced by the University. He / She will be awarded the .....degree during the next convocation of the university.

College Seal

Date:

PRINCIPAL

\*Appropriate course to be filled in (B.E., B.Tech., M.E., M.Tech., M.Sc., and M.Com. MBBS. Etc.)

\*\*Mention Civil, Electrical, Electronics, Chemistry, Biology, Etc.

## IMPORTANT DATES

Download application forms from CCE Web Site		<b>13<sup>th</sup> November 2019</b>	<b>Wednesday</b>
Receipts of application along with fees (upto)	From To	<b>13<sup>th</sup> November 2019</b> <b>29<sup>th</sup> December 2019</b>	<b>Wednesday</b> <b>Sunday</b>
Classes Commence	To	<b>06<sup>th</sup> January 2020</b>	<b>Monday</b>
Final Exams	From To	<b>04<sup>th</sup> May 2020</b> <b>09<sup>th</sup> May 2020</b>	<b>Monday</b> <b>Saturday</b>

### CCE-PROFICIENCE

#### Coordinator,

Indian Institute of Science,  
Bangalore - 560 012

**Phone:** + 91 080 22932508

**E-mail:** [prof.cce@iisc.ac.in](mailto:prof.cce@iisc.ac.in)

**URL:** [www.cce.iisc.ac.in/proficiency](http://www.cce.iisc.ac.in/proficiency)

#### Working Hours:

**Monday through Friday:** 09.30 hrs. to 19.00 hrs.

**Saturdays':** 10.00 hrs. to 16.00 hrs.

