

Detailed Syllabus

Course Code	15B1NHS832	Semester Even (specify Odd/Even)	Semester VIII Session 2023-2024 Month from Feb-June 2023
Course Name	International Studies		
Credits	3	Contact Hours	3(3-0-0)

Faculty (Names)	Coordinator(s)	Dr. Ila Joshi/ Dr Gaurika Chugh
	Teacher(s) (Alphabetically)	Dr. Gaurika Chugh/ Ila Joshi

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C402-8.1	Demonstrate an understanding of the basic concepts in the area of international studies	Understanding (C2)
C402-8.2	Compare the changes in India's foreign policy in the Cold War era and the post Cold War era	Applying (C3)
C402-8.3	Analyze the major political developments and events since the 20 th century	Analyzing (C4)
C402-8.4	Demonstrate an understanding of the rise of new power centres in the changing world order	Understanding (C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic Concepts	Balance of power and Collective security National Interest and its instruments	4
2.	An Overview of Twentieth Century International Relations History	World War I: Causes and Consequences Significance of the Bolshevik Revolution Rise of Fascism / Nazism World War II: Causes and Consequences	8
3.	Cold War Politics	Origin of the Cold War Evolution of the Cold War Collapse of the Soviet Union Causes of the End of the Cold War	8
4.	India's foreign policy during the Cold War era	Basic Determinants (Historical, Geo-Political, Economic, Domestic and Strategic) India's Policy of Non-alignment	6
5.	India's foreign policy in the Post-Cold War era	India and SAARC India and the Look East policy Impediments to regional co-operation: river water disputes; illegal cross-border migration; ethnic conflicts and insurgencies; border disputes	8
6.	Emergence of Other Power Centres	European Union Rise of Asia Powers- Russia, China and Japan	8
Total number of Lectures			42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Project/ Quiz/Attendance)
Total	100

Project Based Learning: Each student would form a group of 3-4 and submit projects on India's foreign policy and rise of new power centres. This project would help the students' research about the India's relations- economic, political and diplomatic and also consider a variety of perspectives and interpretations of current world events.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	A. Chatterjee, <i>International Relations Today</i> . Noida, India: Pearson, 2019
2.	Appadorai, &M.S.Rajan, <i>India's Foreign Policy and Relations</i> . New Delhi, India: South Asian Publisher, 1985
3.	E.H. Carr, <i>International Relations between the Two World Wars: 1919-1939</i> . New York, USA: Palgrave, 2009
4.	J. Baylis &S. Smith, Ed. <i>The Globalization of World Politics: An Introduction to International Relations</i> . Oxford, UK: Oxford University Press, 2011
5.	P. Calvocoressi, <i>World Politics: 1945—2000</i> . Essex, UK: Pearson,2009
6.	P.Zelikow, <i>The Road less travelled: The secret battle to end the great war,1916-17</i> . New York, USA: Public Affairs, 2021
7.	R,Cooper, <i>The Ambassadors: thinking about diplomacy from Machiavelli to modern times</i> . London,UK: Weidenfeld & Nicolson, 2021

Course Description

Course Code	15B29CI891	Semester ODD (specify Odd/Even)	Semester VIII Session 2022 -2023 Month from Janto June 2023
Course Name	Project Part – 2 (DD)		
Credits	8	Contact Hours	...

Faculty (Names)	Coordinator(s)	Prashant Kaushik
	Teacher(s) (Alphabetically)	Entire Department

COURSE OUTCOMES		COGNITIVE LEVELS
C452.1	Summarize the contemporary literature and explore tools for hands-on in the respective project area	Understand Level (Level 2)
C452 .2	List out the specific requirements to develop the workable solution for the identified computing problem	Analyze Level (Level 4)
C452 .3	Develop a working model for the identified problem	Apply Level (Level 3)
C452 .4	Inspect the developed solution using exhaustive test cases and evaluate its performance using statistical methods and relevant metrics	Evaluate Level (Level 5)
C452 .5	Report the results and findings of the project in written and verbal formats	Create Level (Level 6)

Module No.	Title of the Module	List of Experiments	CO
1.
2.
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n.

Evaluation Criteria	
Components	Maximum Marks
Mid Semester Viva	20
Final Viva	30
Project Report	20
Day to Day Work	30
Total	100

Project based learning: Each student in a group of 2-3 will have to develop a Major Project based on different real-world problems using any open-source programming language. Students have to study the state-of-the-art methods before finalizing the objectives. Project development will enhance the knowledge and employability of the students in IT sector.

Optimization Techniques (16B1NMA831)

Simplex method and variants, game theory, queuing models, inventory models, network scheduling, CPM and PERT, sequencing problems, discrete and continuous dynamic programming, nonlinear programming problems-numerical methods.

Course Description

Course Code	16B1NMA831	Semester Even	Semester VIII Session 2022-2023 Month from Jan 2022 to June 2022
Course Name	Optimization Techniques		
Credits	3	Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Ram Surat Chauhan	
	Teacher(s) (Alphabetically)	Dr. Ram Surat Chauhan	
COURSE OUTCOMES			COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:			
C402-2.1	apply generalized, revised and dual simplex method for linear programming problems (LPP).		Applying Level (C3)
C402-2.2	apply graphical, algebraic and linear programming techniques for pure and mixed strategy problems in game theory.		Applying Level (C3)
C402-2.3	classify and solve the problems on queuing and inventory models.		Analyzing Level (C4)
C402-2.4	solve and analyze the network scheduling and sequencing problems.		Analyzing Level (C4)
C402-2.5	make use of dynamic programming technique to solve complex linear programming problems.		Applying Level (C3)
C402-2.6	determine numerical solution of nonlinear multidimensional problems.		Evaluating Level (C5)
Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Review of Linear Programming	Convex sets, Linear Programming Problems (LPP), graphical method, simplex method and its variants, revised simplex method, Duality theory, dual simplex method, sensitivity analysis.	08
2.	Game Theory	Rectangular Games, Minmax Theorem, Graphical Solution of $2 \times n$, $3 \times n$, $m \times 2$, $m \times 3$ and $m \times n$ Games, Solution of games using LPP technique.	06
3.	Queuing Theory & Inventory Model:	Introduction, Steady-State Solutions of Markovian Queuing Models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space. Inventory Models: Deterministic and Probabilistic models.	08
4.	Sequencing & Scheduling	Processing of Jobs through Machines: Processing of n jobs through two machines, two jobs through m machines and n jobs through m	07

		machines. Project Scheduling: Network diagram, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT).	
5.	Dynamic Programming	Discrete and Continuous Dynamic Programming: Bellman's principle of optimality, linear and nonlinear dynamic programming problems, Simple Illustrations.	06
6.	Nonlinear Programming	Unimodal function, One Dimensional minimization problem: Newton's method, Golden section method, Fibonacci search method, Bisection method. Multidimensional minimization problem: Steepest descent method, Multidimensional Newton's method.	07
		Total number of Lectures	42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Quiz, Assignments)	
Total		100	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)			
1.	Taha, H. A., Operations Research - An Introduction, Tenth Edition, Pearson Education, 2017.		
2.	Rao, S. S. - Engineering Optimization, Theory and Practice, Third Edition, New Age International Publishers, 2010.		
3.	Hillier F., Lieberman G. J., Nag,B. and Basu, P., Introduction to Operations Research, 10th edition, McGraw-Hill, 2017.		
4.	Wagner, H. M., Principles of Operations Research with Applications to Managerial Decisions, 2 nd edition, Prentice Hall of India Pvt. Ltd., 1980.		

CO-PO-PSO Mapping:

CO-PO and CO-PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
C40 2-2.1	3	3	1	1								2		
C40 2-2.2	3	3	2	2								2		
C40 2-2.3	3	3	2	2								2		
C40 2-2.4	3	3	3	3								2		
C40 2-2.5	3	3	3	2								1		
C40 2-2.6	3	2	3	2								1		
Avg.	3	3	2	2								2		

Detailed Syllabus
Lecture-wise Breakup

Subject Code	17B1NHS732	Semester: Even	Semester: 8th Session: 2022 -2023 Month: January to June
Subject Name	INDIAN FINANCIAL SYSTEM		
Credits	3	Contact Hours	3 (3-0-0)

Faculty (Names)	Coordinator(s)	1. Dr. Mukta Mani (Sec 62) 2. Dr Sakshi Varshney (Sec 128)
	Teacher(s) (Alphabetically)	2. Dr Mukta Mani 2. Dr Sakshi Varshney

NBA Code	Course Outcomes	Cognitive Level
C402-31.1	Understand the interlinkage of components of the financial system and financial instruments of the Money market and Capital market.	C2
C402-31.2	Analyze ways of fundraising in domestic and international markets	C4
C402-31.3	Understand the functioning of the Stock market and evaluate securities for investment.	C5
C402-31.4	Apply the knowledge of Mutual Funds and Insurance in personal investment decisions	C3
C402-31.5	Apply knowledge of Income tax for the calculation of the tax liability of an individual.	C3

Module No.	Subtitle of the Module	Topics in the module	No. of Hours
1.	Introduction	Meaning, Importance, and functions of Financial system. Informal and Formal financial systems, Financial markets, Financial Institutions, Financial Services and Financial instrument	3
2.	Money Market	Features of money market Instruments: Treasury bills, commercial bills, commercial papers, certificates of deposit, call and notice money, Functions of money market, Linking of money market with Monetary policy in India	3
3.	Capital Market	Features of Capital market instruments: Equity shares, Bonds. Fundraising through Initial Public Offering, Rights issue, Preferential allotment and Private Placement. Process of IPO-Intermediaries in IPO, Book building process and allotment of shares	3

4.	Foreign investments in India	Fundraising from the foreign market through Foreign direct investment and foreign institutional investment, ADR, GDR, ECB, and Private equity.	3
5.	Stock Market	Trading in the secondary market- Stock exchanges, regulations, demutualization, broker, a listing of securities, dematerialization, trading, short selling, circuit breaker, stock market indices- methods of calculation of indices.	3
6.	Stock Valuation and Analysis	Investing basics: Consideration of Risk and Return, Stock Valuation and Analysis- Fundamental analysis: Economy, industry and company analysis; Technical Analysis of stocks using technical charts	7
7.	Investing in Mutual Funds and Insurance	Mutual Funds: Basics, Types of funds, risk and return considerations in the selection of funds; Insurance: Basics, Life insurance and health insurance, types of policies	6
8.	Overview of Income Tax	Basics of Income tax Concept of the previous year, assessment year, person, income. Calculation of Income tax liability for individuals: Income from salaries- basic, DA, HRA, leave salary, Gratuity, Pension, Allowances and Perquisites; Income from Capital Gain, Deductions under sections 80C to 80U.	14
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Project, Class participation and Attendance)	
Total		100	

Project-Based Learning: The students will form groups of 4-5 students. They will carry out a stock analysis of a selected company on the basis of fundamental and technical analysis techniques studied in lecture classes. Finally, they will give their recommendation about the performance of the stock.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Textbooks, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1	Pathak Bharti V, <i>Indian Financial System</i> , 5 th Edition, Pearson Education, 2018
2	Madura Jeff, <i>Personal Finance</i> , 6 th Ed, Pearson Education, 2017.
3	Machiraju H R, <i>Indian Financial System</i> , 5 th Ed, Vikas Publication, 2019

4	Bhole L M and Mahakud, J., <i>Financial Institutions and Markets</i> , 5 th ed. Tata McGraw Hill Publication, 2017.
5	Singhania & Singhania, <i>Students Guide to Income Tax</i> , 67 th Edition, Taxmann Publication, August 2022.
6	<i>How to Stimulate the Economy Essay</i> [Online] Available: https://www.bartleby.com/essay/How-to-Stimulate-the-Economy-FKJP5QGATC
7	Reserve Bank of India, 'Money Kumar & the Monetary Policy', 2007
8	Ashiwini Kumar, Sharma, 'De-jargoned: Book building process, Live Mint, 2015.
9	Madhavan, N. "Pushing the accelerator instead of brakes: Can Subhiksha make a comeback?", <i>Business Today</i> , 28 th June 2009.
10	Kaul, Vivek, "Master Move: How Dhirubhai Ambani turned the tables on the Kolkata bear cartel", <i>The Economic Times</i> , July 1, 2011.

Detailed Syllabus Lecture-wise Breakup

Subject Code	17M11CS122	Semester: Even (specify Odd/Even)	Semester II Session 2022-2023 Month from Jan'23 to June'23
Subject Name	Performance Evaluation of Computing Systems		
Credits	3	Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Kavita Pandey	
	Teacher(s) (Alphabetically)	Dr. Kavita Pandey	

COURSE OUTCOMES		COGNITIVE LEVELS
C114.1	Demonstrate the ability to describe the correct tools and techniques for computer system performance evaluation	Understand (level 2)
C114.2	Identify the probability distribution in a given stream of data that corresponds to a source of randomness in a system.	Apply (level 3)
C114.3	Design the appropriate model of a discrete, dynamic, stochastic system using the theory of random processes.	Apply (level 3)
C114.4	Inspect the mathematical modeling techniques, Markov chains, queuing theory for analyzing the system.	Analyze (level 4)
C114.5	Select the appropriate experiments and perform a simulation study of the given system.	Evaluate (level 5)

Module No.	Title of the Module	Topics in the module	No. of Lectures for the module
1.	Overview of Performance Evaluation	Need for Performance Evaluation, Systematic approach to Performance Evaluation, Selection of evaluation techniques and performance metrics	5
2.	Random Variables and Probability distributions	Discrete and continuous random variable, Expectation and variance, Bernoulli random variable, Binomial distribution, Poisson distribution, Geometric distribution, Normal and Exponential distribution, Normal approximation and Poisson approximation to binomial distribution, hazard rate function, , Comparing systems using sample data, Confidence interval	10
3.	Markov Process	Introduction and classification of stochastic processes, Discrete time and Continuous time markov chains, Birth and death processes , Transition probabilities, Steady state solution, Performance measure in terms of time spent and expected reward	6
4.	Queuing models	Basics of Queuing theory, Kendall notation, Little's Law, Analysis of a single queue	8

		with one server and multiple servers, Analysis of finite buffers queuing systems	
5.	Simulation modeling	Introduction to simulation, Types of simulation, Random number generation, a survey of random number generators, seed selection, testing random number generators, random variate generation	6
6.	Measurement techniques and tools	The art of data presentation, Ratio Games	2
7.	Experimental design and analysis	Types of Experimental designs, 2^2 factorial designs, General 2^K factorial designs, 2^{K-p} fractional factorial designs	5
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Attendance (10 Marks), Assignments / Quiz / Mini project (15 Marks))	
Total		100	
Project based Learning: Each student in a group of 2-3, study the research papers related to experimental designs and present their summary in the form of report. To make it application based, students select the recent articles which is applied on various contemporary domains. Understanding the research papers gives them the knowledge about applicability of experimental designs in identifying the important factors, their variations, etc.			
Recommended Text books:			
1.	Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", Wiley, Reprint Edition, © 2014.		
2.	K.S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2 nd Edition, Reprint Edition, © 2018.		
Recommended Reference books:			
1.	Ross, Sheldon M. "A First Course in Probability". Upper Saddle River, N.J.: Pearson Prentice Hall, 10 th Edition, ©2019		
2.	Obaidat, Boudriga, " <i>Fundamentals of Performance Evaluation of Computer and Telecommunication Systems</i> ", 2010, Wiley, ISBN 978-0-471-26983		
3.	Ross, Sheldon M. "Introduction to Probability Models". Amsterdam: Academic Press, 12 th Edition, ©2019		
4.	Fortier, Michel, "Computer Systems Performance Evaluation and Prediction", 2003, Elsevier, ISBN 1-55558-260-5		

Course Description

Subject Code	18B12HS815	Semester Even	Semester VIII Session 2022-23 Month from Jan to June 2023
Subject Name	QUALITY ISSUES IN ENGINEERING		
Credits	3 (3-0-0)	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Akarsh Arora
	Teacher(s) (Alphabetically)	Dr. Akarsh Arora

COURSE OUTCOMES		COGNITIVE LEVELS
C402-32.1	Apply the concepts of quality within quality management systems by understanding various perspectives, historical evolution; and contributions of key gurus in the field of quality	Apply Level (C3)
C402-32.2	Determine the effectiveness of acceptance sampling using single and double sampling plans and operating characteristic curves	Evaluate Level (C5)
C402-32.3	Determine quality by employing a wide range of basic quality tools, lean concepts and process improvement techniques such quality function deployment	Evaluate Level (C5)
C402-32.4	Examine the importance of six sigma, various quality standards, awards, certifications	Analyze Level (C4)

Module No.	Subtitle Of The Module	Topics In The Module	No. Of Lectures For The Module
1.	Fundamentals And Evolution Of Quality	Introduction, Dimensions Of Quality, Fundamentals, History Of TQM, Contemporary Influences	6
2.	Quality Tools And The Improvement Cycle	Various Costs, Juran's Coq Accounting Statement, Voice Of Customers: Kano's Model, House Of Quality, QFD Process, Seven Tools For Quality Management	9
3.	Benchmarking	Meaning, Process, Methods	3
4.	Quality Gurus	Contribution of Quality Gurus	3
5.	Six Sigma	Six Sigma, Capability Of A Process/Product/Service, DMAIC Process	6
6.	Lean Concepts	Kaizen, Poka-Yoke, Andon, Kanban, JIT, 5-S, 7 Mudass	3
7.	Statistical Thinking And Applications	Statistical Process Control, Acceptance Sampling, Specification And Control Limits, Control Charts For Variables, Control Charts For Attributes	6

8.	Quality Awards And Certifications	MBNQA, RGNQA, Deming Prize, ISO Standards	3
9.	Quality Strategy For Indian Industry	India's Quality Journey, Quality Management In India	3
Total Number Of Lectures			42

Project-based Learning: Students are required to visit any business organization to observe the brief about the organization; its products; its suppliers; its operations; its processes, Quality control system and techniques followed by the company, Quality standards met by the company, application of quality tools or lean manufacturing system, Sigma capability of products or processes, DMAIC methodology, application and relevance of the quality concepts studied in the course. Collecting information on quality systems, quality standards, quality certifications or awards received, and sigma capability will upgrade students' knowledge and strengthen their skills to tackle multiple quality engineering issues along with employability.

Evaluation Criteria	
Components	Maximum Marks
T1	20 (Written)
T2	20 (Written)
End Term	35 (Written)
TA	25 (Project Assignment, Quiz)
Total	100

Recommended Reading material:	
1.	Besterfield D. H., Besterfield-Michna C., Besterfield G. H., Besterfield-Sacre M. <i>Total quality management</i> , Prentice Hall, 1999.
2.	Evans, J. R., Dean J. W. <i>Total quality management, organization and strategy</i> , Thomson, 2003. 399 p.
3.	Kanji G. K., Asher M. <i>100 Methods for Total Quality Management</i> . London: SAGE Publications, 1996.
4.	Oakland G. F. <i>Total Quality Management</i> , Oxford, 1995.
5.	Goetsch D. L., Davis S. B. <i>Quality management. Introduction to TQM for production, processing and services</i> . New Jersey: Prentice Hall, 2003.
6.	John S. Oakland. <i>Total Quality Management and Operational Excellence: Text with cases</i> , Fourth edition, 2014
7.	Dale H. Besterfield. <i>Total Quality Management</i> , (Revised Edition). India: Pearson, 2011.

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12PH812	Semester: Even	Semester: 8, Session : 2022 -2023 Month from: January to June
Course Name	Astrophysics		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Prof. Anirban Pathak
	Teacher(s) (Alphabetically)	Anirban Pathak

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Relate historical development of astrophysics with the modern concepts and recall the mathematical techniques used & definition of different units	Remembering (C1)
CO2	Explain the models of universe, ideas of stellar astrophysics, life cycles of stars, physical principles that rules galaxies, and general theory of relativity	Understanding (C2)
CO3	Apply mathematical principles and laws of physics to solve problems related to astrophysical systems	Applying (C3)
CO4	Compare different models of universe and decide which one is logically acceptable and why	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1	Introduction to Astrophysics	Historical development of astrophysics (from mythology to contemporary astrophysics), Mass, length and time scales in astrophysics, sources of astronomical information (effect of discovery of spectroscopes and photography), astronomy in different bands of electromagnetic radiation (e.g. Optical astronomy, infra-red astronomy radio astronomy, X-ray astronomy. Gamma-ray astronomy etc. with specific mention of Hubble space telescope). Kirchoff's law, Doppler effect and Hubble's law.	8
2.	Stellar Astrophysics	Classification and nomenclature of stars. Basic equations of stellar structure, main sequence, red giants and white dwarfs, HR diagram, stellar evolution, supernovae, extra solar planets.	8
3.	Death of a star	End states of stellar collapse: degeneracy pressure of a Fermi gas, structure of white dwarfs, Chandrasekhar mass limit, neutron stars pulsars and black holes.	6
4.	Our galaxy	The shape and size of Milky way and its interstellar mater	2
5.	Extragalactic astrophysics	Normal galaxies, active galaxies, cluster of galaxies, large-scale distribution of galaxies.	6
6.	GTR and Models of Universe	Qualitative idea of general theory of relativity (without using tensor calculus) and its implications. Different models of universe. Specific attention to the ideas	6

		related to big bang, cosmological constants, dark matter and dark energy.	
7.	Astrobiology	Drake equation and related questions.	2
8.	Conclusion	Review of the present status of Astrophysics and open questions.	2
Total number of Lectures			40
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25	
		(a) Quizzes /class tests (05 M), (b) Attendance (05 M) (c) Internal Assessment (05) (d) Assignments in PBL mode (10 M)	
Total		100	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press, Delhi, 2010.
2.	Astrophysics: Stars and Galaxies, K D Abhyankar, University Press, Hyderabad, 2009.
3.	Facts and Speculations in Cosmology, J V Narlikar and G Burbidge, Cambridge University Press, Delhi, 2009.
4.	The Cosmic Century, Malcolm Longair, Cambridge University Press, Cambridge, 2006.
5.	An Introduction to Astrophysics, Baidyanath Basu, Prentice Hall of India, Delhi 1997.
6.	Fundamentals of Equations of State, S. Eliezer, A Ghatak and Heinrich Hora, World Scientific, Singapore, 2002. Only Chapter 15.

Project based learning: Project report (5-7 pages in pdf format indicating Name, Enroll No. and Batch) is to be uploaded in google class room before starting of End Term Exam. Max 5 students can work on one topic given in the list (Dark Matter, Dark Energy, Expanding Space time, Merger of Black holes, Failed stars, Detection of Gravitational Waves, Light cone in GTR, Particle production radiation era, Did big bang happened ?, Discover life: ET etc.), however, they may prepare different reports. Report should include introduction, definition, mathematics, principle, working, figures, applications etc.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	19M13HS111	Semester: Even	Semester: M.Tech II & Dual degree VIII Session 2022-23 Month from January to May 2023
Subject Name	English Language Skills for Research Paper Writing		
Credits	2	Contact Hours	2-0-0
Faculty (Names)	Coordinator(s)	Dr. Ekta Singh	
	Teacher(s) (Alphabetically)	Dr. Ekta Singh	

Course Outcomes:

At the completion of the course, students will be able to,

COURSE OUTCOMES		COGNITIVE LEVELS
C204.1	Demonstrate an understanding of all the aspects of grammar and language needed to write a paper.	Understand Level (C2)
C204.2	Apply grammatical knowledge & concepts in writing and presentation.	Apply level (C3)
C204.3	Examine each section of a paper after careful analysis of Literature Review.	Analyze Level (C4)
C204.4	Determine the skills needed to write a title, abstract and introduction, methods, discussion, results and conclusion.	Evaluate Level (C5)
C204.5	Compile all the information into a refined research paper after editing and proofreading	Create Level (C6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures and Tutorials for the module
1.	Grammar & Usage	Structure of English Language Voice, Aspect & Tense SVOCA Sense & Sense Relations in English Enhancing Vocabulary Connotation, Denotation & Collocation	6
2.	Elements of Paper Writing	Planning & Preparation Word Order Breaking Long Sentences Structuring Paragraphs Being Concise and Removing Redundancy Avoiding Ambiguity and Vagueness	4
3.	Paraphrasing & Writing	Highlighting Your Findings Hedging and Criticising Paraphrasing and Plagiarism Sections of a Paper Abstracts; Introduction	6

4.	Process of Writing	Review of Literature Methods Results Discussion Conclusion The Final Check	4
5.	Key Skills Needed	Key skills needed when writing a Title Key skills needed when Writing an Abstract Key skills needed when writing an Introduction Key skills needed when writing a Review of the Literature Key skills needed when writing Methods & Results Key skills needed when writing Discussion & Conclusion	4
6.	Refining the Paper	Incorporating useful phrases Editing Proofreading References Annexures Ensuring good quality in submission	4
Total number of Lectures and Tutorials			28

Evaluation Criteria	
Components	MaximumMarks
Mid Term	30
End Semester Examination	40
TA	30 (Project, Assignment/ Class Test/ Quiz, Class Participation)
Total	100

3. Employability/entrepreneurship/skill development

Researchers whose first language is not English write at least two-thirds of published scientific papers. Twenty percent of the comments referees make when reviewing papers for possible publication in international journals regard English language issues. In some disciplines, acceptance rate by journals of papers originating from the US/UK is 30.4%, and is higher than all other countries

Publishing your research in an international journal is key to your success in academia. This course is based on a study of some sample manuscripts and reviewers' reports revealing why papers written by non-native researchers are often rejected due to problems with English usage and poor structure and content. The course prepares the students on how to:

- prepare and structure a manuscript
- increase readability and reduce the number of mistakes you make in English by writing concisely, with no redundancy and no ambiguity
- write a title and an abstract that will attract attention and be read
- decide what to include in the various parts of the paper (Introduction, Methodology, Discussion etc)
- highlight your claims and contribution
- avoid plagiarism
- discuss the limitations of your research
- choose the correct tenses and style
- satisfy the requirements of editors and reviewers

Recommended Reading material:	
1.	Goldbort R. 'Writing for Science', Yale University Press (available on Google Books), 2006
2.	Day R. 'How to Write and Publish a Scientific Paper', Cambridge University Press, 2006
3.	Adrian Wallwork. 'English for Writing Research Papers', Springer, New York, Dordrecht Heidelberg, London, 2011
4.	Yadugari M.A. ' Making Sense of English: A Textbook of Sounds, Words & Grammar' Viva Books Private Limited, New Delhi, 2013, Revised Edition
5.	Strauss Jane. 'The Blue Book of Grammar and Punctuation, Josseybass, Wiley, San Francisco, 1999.
6.	Rizvi, A. R. 'Effective Technical Communication' 2nd edition, McGraw Hill Education Private Limited, Chennai, 2018
7.	Eckert, K. 'Writing Academic Paper in English:Graduate and Postgraduate Level', Moldy Rutabaga Books, 2017
8	Barros, L.O, 'The Only Academic Phrasebook You'll Ever Need: 600 Examples of Academic Language' Create Space Independent Publishing Platform; 1st edition,2016
9	Wallwork, A. 'English for Writing Research Papers (English for Academic Research)'.Springer; 2nd ed. 2016 edition.
10	Wallace,M&Wray,A. 'Critical Reading and Writing for Postgraduates (Student Success) SAGE Publications Ltd; Third edition, 2016
11	Butler, L. 'Longman Academic Writing Series 1: Sentences to Paragraphs, with Essential Online Resources', Pearson Education ESL; 2nd edition,2016
12	Saramäki, J. 'How to Write a Scientific Paper: An Academic Self-Help Guide for PhD StudentsIndependently published, 2018

Multi Attribute Decision Making (20B12MA411)

Course Code	20B12MA411	Semester Even	Semester VIII Session 2022 -2023 Month from Jan 2023 to June 2023
Course Name	Multi Attribute Decision Making		
Credits	3	Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Dinesh C. S. Bisht	
	Teacher(s) (Alphabetically)	Dr. Dinesh C. S. Bisht	
COURSE OUTCOMES			COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:			
CO-1	explain basic steps in decision analysis and decision-making environments.	Understanding Level (C2)	
CO-2	apply group decision making methods to reach a collective decision.	Applying Level (C3)	
CO-3	develop the concept of multi criteria decision making process and attributes.	Understanding Level (C2)	
CO-4	apply elementary methods to solve multi attribute decision making problems.	Applying Level (C3)	
CO-5	analyze value based and outranking methods to solve multi attribute decision making problems.	Analyzing Level (C4)	
Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Decision Analysis	Basic Steps in Decision Analysis, Decision-Making Environments, Decision Making Under Uncertainty, Decision Making Under Risk, Utility Theory, Decision Tree.	8
2.	Group Decision Making	GDM Methods, Content-Oriented Methods, and Disadvantages of Non ranked Voting, Preferential Voting System, and Social Choice Functions.	7
3.	Multicriteria Decision Making	Multi-attribute Decision Making, Multi Objective Decision Making, Decision Making Process, Structuring Process, Decision Matrix, Attributes, Normalization, Attribute Weight Assignment Methods.	8
4.	Elementary Methods for	Dominance Relation method, Even-Swap method, Lexicographic method Maximax method, Maximin	8

	MADM	method, Conjunctive method, Disjunctive method, Median Ranking, Analytic Hierarchy Process, Analytic Network Process.	
5	Value Based and Outranking Methods	Multi Attribute Value Theory, Simple Additive Weighting, Weighted Product, TOPSIS Outranking Methods.	11
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Quiz and Assignments)	
Total		100	
<p>Project based learning: Students are divided in a group of 4-5 to do a survey on the applications of classical and recent multi attribute decision making techniques in their respective branches. The student recognizes the multi attribute decision making problems arising in real life and solves these problems with the help of MADM techniques learnt in this course.</p>			
<p>Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)</p>			
1.	Ishizaka, Alessio, and Philippe Nemery. <i>Multi-criteria decision analysis: methods and software</i> . John Wiley & Sons, 2013.		
2.	Xu, Zeshui. <i>Uncertain multi-attribute decision making: Methods and applications</i> . Springer, 2015.		
3.	Tzeng, Gwo-Hshiung, and Jih-Jeng Huang. "Multi Attribute Decision Making: Methods and Applications." <i>USA, CRC Press</i> . 2016.		

Detailed Syllabus
Lecture-wise Breakup

Course Code	23M12CS121	Semester 2ndSem (Even)	Semester MTech II Sem Session 2022-23 Month from Jan to June
Course Name	Cryptography and Cybersecurity		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Sangeeta Mittal
	Teacher(s) (Alphabetically)	Dr. Sangeeta Mittal

COURSE OUTCOMES		COGNITIVE LEVELS
C187.1	Understand threats to cybersecurity and secure protocols	Understand Level (Level 1)
C187.2	Apply modern symmetric encryption algorithms for data confidentiality in cyberspace	Apply Level (Level 2)
C187.3	Analyze number theory and its usage in various modern asymmetric encryption algorithms for developing secure solutions	Analyze Level (Level 3)
C187.4	Apply proactive solutions for cybersecurity like Firewalls and IDS in real world systems	Apply Level (Level 3)
C187.5	Evaluate human aspects of cybersecurity like social engineering and password management	Evaluate Level (Level 4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Introduction to Cybersecurity – Types of Attacks, Goals of cybersecurity, Security threats and vulnerabilities, Cybersecurity models (CIA triad, Star model), Role of Cryptography and Steganography	2 [CO1]
2.	Classical Cryptography	Types of Cryptography, Some classical cryptographic algorithms – Affine, Playfair, Vignere, Hill and Autokey Ciphers	3 [CO2]
3.	Symmetric Ciphers	Stream and Block Ciphers, Fiestel Cipher, Confusion and Diffusion, Groups & Fields, Modern Symmetric encryption: DES, AES and RC4, Modes of Encryption	8 [CO2]
4.	Asymmetric Ciphers	Number theory for modular mathematics, RSA, Elgamal Encryption, Diffe-Hellman Key Exchange, Elliptic-curve cryptography	9 [CO3]
5.	Cybersecurity Protocols	Cybersecurity protocols at different layers with respect to TCP/IP stack, IPSEC (IP Security – IP Authentication Header, Payload Encapsulation), PPTP and SSL	5 [CO1]
6.	Intrusion Detection and Response	Goals for Intrusion Detection Systems, Types of IDSs – Anomaly Based and Signature Based ,Intrusion Prevention Systems, Intrusion Response	5 [CO4]

7.	Firewalls	Design of Firewalls, Types of Firewalls, Personal Firewalls, Example Firewall Configurations, Network Address Translation (NAT), Data Loss Prevention	5 [CO4]
8.	Human Aspects of Cybersecurity	Social Engineering, Phishing and its types, Protection from phishing, Passwords – choosing passwords, password cracking, attacking systems via passwords, biometric authentication and error rates	5 [CO5]
Total number of Lectures			42
Evaluation Criteria			
Components		MaximumMarks	
T1		20	
T2		20	
EndSemesterExamination		35	
TA		25 (Assignments + PBL + Attendance)	
Total		100	

Project based learning:

Students form group of size 2-3 members. Each group will identify several issues in existing cryptographic algorithms and their applications. Once problem has been identified, the group will analyze the problem and synthesize solutions to the identified problem. Analysis and application of symmetric, asymmetric and hash algorithms. This approach will enhance the understanding of security issues in distributed applications. Moreover, they will gain enough knowledge to provide the cryptographic solution to enhance the security of any organization/company. After this course, a student will be able to undertake any work in this area in the industry or research.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Cryptography & Network Security, Forouzan, Tata McGraw Hill
2.	Introduction to Modern Cryptography (3rd edition) By Jonathan Katz and Yehuda Lindell, CRC Press, 2020
3.	Cryptography and Network Security <i>Principles and Practice</i> , Sixth Edition, William Stallings, Pearson
4.	Understanding Cryptography, Christofer Paar, Jen Pelzl, Springer , 2000
5.	USENIX Security Symposium
6.	ACM Transactions on Information and system security
7.	IEEE Press Computer Security and Privacy

**Detailed Syllabus
Lecture-wise Breakup**

Course Code	23M22CS122	Semester :II	Session : 2022-23
Course Name	Statistics for Data Science		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Niyati Aggrawal
	Teacher(s) (Alphabetically)	Dr. Niyati Aggrawal

COURSE OUTCOMES		COGNITIVE LEVELS
C184.1	Understand the basic principle of probability and statistics and its need in the context of data science	Understand Level (Level 3)
C184.2	Develop own statistical analyses and implement them with advanced statistical programming tools	Apply Level (Level 3)
C184.3	Compare the performance of multiple statistical methods and models and articulate the limitations and abuses of formal inference and modeling.	Analyze Level (Level 4)
C184.4	Evaluate statistical techniques for constructing learning models and can use different measures of model fit and performance to assess models.	Evaluate Level (Level 5)
C184.5	Create real world applications using statistical or data modeling techniques and test hypothesis.	Create Level (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Probability and Statistical inference	Modern Statistics, Statistics and Engineering, Probability, Conditional Probability, The Axioms of Probability, Sampling, Randomness, Intro to Statistics: Mean and Variance, Covariance, Types of Convergence.	6
2.	Statistical Methods in Data Science	Data Distribution (Bernoulli, Uniform, Binomial, Normal, Poisson), Mathematical Statistics, Inferential Statistics, Descriptive Statistics, Random Variable, Gauss-Markov theorem, F-distribution	7
3	Hypothesis Testing	Hypothesis Testing, Difference of Means, Significance Level and P-Value, Z-test, ANOVA, T-Test, Redundancy Test, Chi-Square & F-test, Type-I and Type-II errors	7
4.	Data Modeling	Cross validation, Monte Carlo methods, Cluster analysis, Time Series Modeling	6
5.	Introduction to Bayesian Modeling	Bayes' Theorem, Conditional Statements, Bayesian Thinking: priors, posteriors, and Maximum Likelihood Estimation, Bayesian inference	5
6.	Correlation & Regression Models	Correlation Analysis, Linear regression methods, Ridge regression, LASSO Regression, Logistic regression	6
7.	Ensemble Learning	Bagging & Boosting, Random Forest, Adaboost	5
Total number of Lectures			42
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance and Tut Performance (10), Quiz/ Mini-
Project/Assignment (15)	
Total	100

PBL: In this course, students will create a Project in a group size of 3 to 4 for implementing the statistical concepts of data science. They will demonstrate proficiency with statistical analysis of data. Also execute statistical analyses with statistical tools & techniques. They can apply Standard Data Visualization and formal inference procedures and can comment on the results.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Arnold, T., Kane, M., & Lewis, B. W. (2019). A computational approach to statistical learning. CRC Press.
2.	James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). Statistical learning. In An Introduction to Statistical Learning (pp. 15-57). Springer, New York, NY.
3.	Gutierrez, D. D. (2015). Machine learning and data science: an introduction to statistical learning methods with R. Technics Publications.
4.	Lomax, R. G., & Hahs-Vaughn, D. L. (2013). An introduction to statistical concepts. Routledge.
5.	Grus, J. (2019). Data science from scratch: first principles with python. O'Reilly Media.
6.	Chatfield, C., & Xing, H. (2019). The analysis of time series: an introduction with R. CRC press.
7.	Afifi, A., May, S., Donatello, R., & Clark, V. A. (2019). Practical multivariate analysis. CRC Press.
8.	Zumel, N., & Mount, J. (2014). Practical data science with R. Manning Publications Co..
9.	Saltz, J. S., & Stanton, J. M. (2017). An introduction to data science. SAGE Publications.

Detailed Syllabus

Subject Code	17M22CS115	Semester: Even	Semester: M.Tech. II Session: 2022-2023 Month from: Jan to June
Subject Name	Large Scale Graph Algorithms and Analytics		
Credits	3	Contact Hours	3
Faculty (Names)	Coordinator(s)	Dr. Adwitiya Sinha	
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha	

S.No.	Description	Cognitive Level (Blooms Taxonomy)
C161.1	Understand the characteristics & significance of large-scale graphs over complex structures	Understanding Level (Level III)
C161.2	Analyze several techniques to yield and process information from large-scale real-world data sources	Analyzing Level (Level II)
C161.3	Apply the concept of random network theory to large graphs	Applying Level (Level IV)
C161.4	Evaluate the heterogeneous behavior in large-scale graphs with hyper-graphs and multi-graphs for recommendation	Evaluating Level (Level V)
C161.5	Design algorithmic frameworks for large-scale complex interconnected structures	Creating Level (Level VI)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1	Introduction to Large-scale Graphs	Basics of Graph, Multi-Graph, Hypergraph & its Duality, Introduction & Application of Large-scale Graph, Characteristics, Challenges	6
2	Data Sources & Categorization	Complex Data Sources (Social Networks, Simulations, Bioinformatics), Categories – Social graphs (Facebook, Twitter, Google+), Endorsement graphs (Web Link Graph, Paper Citation Graph), Location graphs (Map, Power Grid, Telephone Network), Co-occurrence Graphs (Term-Document Bipartite, Click-through Bipartite)	7
3	Basic Large-scale Graph Analysis	Basic Large-scale Graph Analysis (Efficient Search – Graph Traversal and Search Algorithms; Pattern Discovery -Matching Algorithms, Centrality Computing Algorithms, List Ranking Algorithms; Partitioning – Connected Component Algorithms, Graph-Cut Algorithms)	7

4	Advanced Large-scale Graph Analysis	Advanced Large-scale Graph Analysis (Graph indexing and ranking – Link Analysis Algorithms, Web Crawling, Page Ranking Personalized Page Rank, Page Rank Axioms, HITS; Data Based Approaches – Clustering and Classification Algorithms)	7
5	Computation for Massive Data Sets	Large scale Graph Clustering: Spectral Clustering, Modularity-based Clustering, Random Walks, Social Balance Theory	5
6	Large Graph Representation, Analysis & Implementation	Adjacency Matrix Representation, Adjacency List Representation, Graph Implementation Strategies & Softwares (PowerBI, Python, NetworkX, Pajek, MapReduce, GraphLab, Orange)	5
7	Advanced Research Topics	Power Law Distribution in Social Networks, Models of Power Law Random Graphs, Game-Theoretic Approach to Modeling Network Creation, Rank Aggregation and Voting Theory, Recommendation Systems	5
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		Attendance (15 Marks), Assignment/Quiz/Mini-project (10 Marks)	
Total		100	

Project based learning: Each student in a group of 3-4 will extract data from real-world domains using data streaming, web crawling, application programming interfaces (APIs), or from standard repositories that are globally recognized. For conducting application-based research, the students are encouraged to analyze social/political/financial/disease related data and generate underlying networked structure based on activity and topology. Analysing the real-world data for providing link prediction, community detection, security enhancements, commercial decision making, cost-benefit analysis, etc. using network science algorithms, tools, and analytics.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Deo, Narsingh. <i>Graph theory with applications to engineering and computer science</i> . Courier Dover Publications, 2017.
2.	Gross, Jonathan L., and Jay Yellen, eds. <i>Handbook of graph theory</i> . CRC press, 2003.
3.	Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006), CRC Press.
4.	Bondy, John Adrian, and Uppaluri Siva Ramachandra Murty. <i>Graph theory with applications</i> . Vol. 290. London: Macmillan, 1976.
5.	West, Douglas Brent. <i>Introduction to graph theory</i> . Vol. 2. Upper Saddle River: Prentice hall, 2001.
6.	Bollobás, Béla. <i>Modern graph theory</i> . Vol. 184. Springer Science & Business Media, 2013.