



YESHWANTRAO CHAVAN COLLEGE OF ENGINEERING
(An Autonomous Institution affiliated to R T M Nagpur University Nagpur)
Accredited by NAAC (1st Cycle) with 'A' Grade (Score 3.25 on 4 Point Scale)

Wanadongri, Hingna Road, Nagpur-441110

Department of Electronics Engineering **(Honors in Cryptography(NPTEL))**



B.E. Honors in Cryptography(NPTEL)
SoE & Syllabus 2021-22



Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Department of Electronics Engineering

SoE and Syllabus

B.E Honors in Cryptography (NPTEL)

**SoE No.
HON-101**

B.E Honors in Cryptography(NPTEL)

Information Brochure of Honor Program

- 1. Title of the Program: B.E Honors in Cryptography**
- 2. Type of Program: Honor**
- 3. Department offering the program: Electronics Engineering**
- 4. Industry / Association / Collaboration: NPTEL(Swayam)**
- 5. Department/s eligible to opt for the program:**

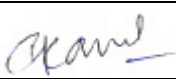

The students of Department of Electronics Engineering are only permitted to opt for this program.

6. General information about courses in program:

The aim of this course is to introduce the student to the areas of cryptography and cryptanalysis. This course develops a basic understanding of the algorithms used to protect users online and to understand some of the design choices behind these algorithms. Our aim is to develop a workable knowledge of the mathematics used in cryptology in this course. The course emphasizes to give a basic understanding of previous attacks on cryptosystems with the aim of preventing future attacks.

The course provides the basic paradigm and principles of modern cryptography. The focus of this course will be on definitions and constructions of various cryptographic objects. We will try to understand what security properties are desirable in such objects, how to formally define these properties, and how to design objects that satisfy the definitions. The aim is that at the end of this course, the students are able to understand a significant portion of current cryptography standards.

The domain of Internet has grown in a rapid pace from traditional circuit switched and packet switched small scale networks to modern high-speed mobile and wireless Internet. A large number of methods, architectures and designs came up at every protocol level to cope up with the demands for developing a secure and highly dependable information technology infrastructure. The broad objective of the course is to understand - (i) the architecture and principles of today's computer networks, (ii) the protocols and their functionalities, (iii) the requirements for the future Internet and its impact on the computer network architecture. In this course, we'll broadly cover the basic

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TCP/IP protocol stack and touch on the next generation computer networks. We'll take a top-down approach to cover different protocols at the TCP/IP protocol stack.

Fundamentals of neural networks and various learning methods will be discussed. The principles of multi-layer feed forward neural network, radial basis function network, self-organizing map, counter-propagation neural network, recurrent neural network, deep learning neural network will be explained with appropriate numerical examples. The method of evolving optimized fuzzy reasoning tools, neural networks will be discussed with the help of some numerical examples.

With increase in the usage of the Internet, there has been an exponential increase in the use of online social media and networks on the Internet. Websites like Facebook, YouTube, LinkedIn, Twitter, Flickr, Instagram, Google+, Foursquare, Pinterest, Tinder, and the likes have changed the way the Internet is being used. However, widely used, there is a lack of understanding of privacy and security issues on online social media. Privacy and security of online social media need to be investigated, studied and characterized from various perspectives (computational, cultural, psychological, etc.). Student completing the course will be able to appreciate various privacy and security concerns (spam, phishing, fraud nodes, identity theft) on Online Social Media and Student will be able to clearly articulate one or two concerns comprehensively on one Online Social Media, this will be achieved by homework.

This course will focus on the importance of addressing different security threats on modern hardware design, manufacturing, installation, and operating practices. In particular, the threats would be shown to be relevant at scales ranging from a single user to an entire nations public infrastructure. Through theoretical analyses and relevant practical world case studies, the threats would be demonstrated, and then state-of-the-art defense techniques would be described. The course would borrow concepts from diverse fields of study such as cryptography, hardware design, circuit testing, algorithms, and machine learning.

7. Advance knowledge or research orientation of Program

Modern cryptography is heavily based on mathematical theory and computer science practice; cryptographic algorithms are designed around computational hardness assumptions, making such algorithms hard to break in actual practice by any adversary. While it is theoretically possible to break into a well-designed system, it is infeasible in actual practice to do so. Such schemes, if well designed, are therefore termed "computationally secure"; theoretical advances, e.g., improvements in integer factorization algorithms, and faster computing technology require these designs to be continually re-evaluated, and if necessary, adapted. There exist information-theoretically secure schemes that provably cannot be broken even with unlimited computing power, such as the one-time pad, but these schemes are much more difficult to use in practice than the best theoretically breakable but computationally secure schemes.

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Advanced topics like identity-based encryption, attribute-based encryption, functional encryption, two-party/multi-party computation, bit coin and crypto-currency and post quantum cryptography. The cryptanalysis part will help us understanding challenges for cyber security that includes network security, data security, mobile security, cloud security and endpoint security.

8. Employability potential of program:

Cryptography is the art and science of hiding and deciphering information through the use of codes. Government agencies, private industries and military organizations need individuals trained in cryptography for a variety of jobs, ranging from code makers and code breakers to language analysts and information security specialists. The Internet is used by the vast majority of our population in one form or another, and this new world needs a great deal of protection. If you're interested in being one of the sheriffs of the cyber world, there are several career options available to you. Ciphers, algorithms and security systems are put into code by a Cryptographer. As a cryptographer you are in complete control of those codes and protecting those codes from the cyber hackers. Cryptography is a career with options working for the government, insurance agencies, universities, and more.

9. Departmental Steering committee: For proper publicity / conduct of program

SN	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Dr. P. T. Karule	Chairman	Prof. & Head	ptkarule@gmail.com	9764996490
2	Dr. S. V. Rathkantiwar	Member	Professor	svr_1967@yahoo.com	9764996797
3	Dr. A. S. Khobragade	Member	Professor	atish_khobragade@rediffmail.com	9765005110
4	Dr. R. D. Thakre	Member	Professor	rdt2909@gmail.com	9423603236

10. Program Coordinator:

SN	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Vilas Alagdive	Coordinator	Asst.Professor	vilas_a23@rediffmail.com	7768842506

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Scheme of Examinations Honors in Cryptography (SWAYAM/NPTEL Courses)

SN	Sem	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA**	ESE	
1	5	EEHN01	Computer Networks and Internet Protocol	T				3	3	This is SWAYAM / NPTEL based program and COURSES with 12–14-week syllabus are expected to be available on SWAYAM/NPTEL platform. If they are not available before the commencement of semester, Similar / Equivalent Subjects shall be notified by BoS of the Department. Chairman BoS will notify all the subjects which are 12-14 week duration before the commencement of academic session.			
2	5	EEHN02	Data Analytics with Python	T				3	3				
3	6	EEHN11	Deep Learning	T				3	3				
4	6	EEHN12	Cryptography and Network Security	T				3	3				
5	7	EEHN21	Privacy and Security in Online Social Media	T				3	3				
6	7	EEHN22	Hardware Security	T				3	3				
TOTAL								18	18				

MSEs* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 20 marks on lecture quizzes, 8 marks on assignments, 2 marks on class performance

TA = for Practical : MSPA will be 15 marks each**

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5th Semester

EEHN01	Computer Networks & Internet Protocol			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme <i>*Best Two out of three MSE's would be considered</i>	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs
Prerequisites	Nil						
Course Objective Students will be able to understand (i) the architecture and principles of today's computer networks (ii) the protocols and their functionalities (iii) the requirements for the future internet and its impact on the computer network architecture				Course Outcome Students will be able to 1. Learn methods, architectures and designs of computer networks that came up at every protocol level.			
UNIT I : Introduction to Computer Networks – History, Circuit Switching and Packet Switching, TCP/IP Protocol Stack – Basic Overview, Application Layer Services (HTTP, FTP, Email, DNS)							
UNIT II : Transport Layer Primitives – Connection Establishment and Closure, Flow Control and Congestion Control at the Transport Layer							
UNIT III : Transmission Control Protocol – Basic Features, TCP Congestion Control, Network Layer Primitives – IP Addressing							
UNIT IV : IP Routing – Intra Domain Routing Protocols, Inter Domain Routing Protocols (BGP), IP Services – SNMP, ARP							
UNIT V: Data Link Layer Service Primitives – Forwarding, Flow Control, Error Control							
UNIT VI: Media Access Control - Channel Access Protocols, Framing, End to End Principles of Computer Networks							

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Text Books:

	Title	Edition	Author	Publisher
1	Computer Networking: A Top - Down Approach	6 th Edition	Ames Kurose, Keith Ross	Pearson
2	Computer Networks	5 th Edition	Andrew S Tanenbaum	Pearson

Reference Book:

	Title	Edition	Author	Publisher
1	Computer Networks: Systems Approach Book	5 th	Bruce S. Davie and Larry L. Peterson	MKP.COM

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5th Semester

EEHN02	Data Analytics & Python			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs

Prerequisites**Course Objective**

Students should be able to

Course Outcome

Students will be able to

- 1)Learn analytics in their career and life
- 2)Get hands on experience in creating analytics models
- 3)Learn to use various tools

UNIT I : Introduction to data analytics and Python fundamentals, Introduction to probability**UNIT II :** Sampling and sampling distributions, Hypothesis testing**UNIT III :** Two sample testing and introduction to ANOVA, Two way ANOVA and linear regression**UNIT IV :** Linear regression and multiple regression, Concepts of MLE and Logistic regression**UNIT V:** ROC and Regression Analysis Model Building, χ^2 Test and introduction to cluster analysis**UNIT VI:** Clustering analysis, Classification and Regression Trees (CART)**Text Books:**

	Title	Edition	Author	Publisher
1	Python for data analysis: Data wrangling with Pandas, NumPy, and IPython.	(2012)	McKinney, W.	O'Reilly Media, Inc.
2	A Byte of Python. Python Tutorial.	(2003)	Swaroop, C. H.	Ebshelf.com

Reference Book:

	Title	Edition	Author	Publisher
1	Business Statistics for Contemporary Decision Making	6 th dition	Ken Black,	John Wiley & Sons, Inc

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6th Semester

EEHN11	Deep Learning			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs
Prerequisites							
Course Objective Students should be able to	Course Outcome Students will be able to 1) Acquire the knowledge of applying Deep Learning Techniques to solve various real life problems						
UNIT I : Introduction to Deep Learning, Bayesian Learning, Decision Surfaces, Linear Classifiers							
UNIT II : Optimization Techniques, Gradient Descent, Batch Optimization, Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning							
UNIT III : Unsupervised Learning with Deep Network, Autoencoders, Convolutional Neural Network, Building blocks of CNN, Transfer Learning							
UNIT IV : Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam, Effective training in Deep Net-early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization							
UNIT V: : Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc., Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic Segmentation, Object Detection etc.							
UNIT VI: LSTM Networks, Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam							

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Text Books:

	Title	Edition	Author	Publisher
1	Deep Learning	2016	Ian Goodfellow, Yoshua Benjio, Aaron Courville	The MIT Press

Reference Book:

	Title	Edition	Author	Publisher
1	Pattern Classification	2 nd Edition	Richard O. Duda, Peter E. Hart, David G. Stork,	John Wiley & Sons Inc.

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6th Semester

EEHN12	Cryptography & Network Security			L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme <i>*Best Two out of three MSE's would be considered</i>	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective

Students should be able to

Course Outcome

Students will be able to

- 1) Understand the algorithms used to protect users online and understand some of the design choices behind these algorithms
- 2) Understand previous attacks on cryptosystems with the aim of preventing future attacks
- 3) Learn the challenges involved for cybersecurity that includes network security, data security, mobile security, cloud security and endpoint security

UNIT I :

Introduction to cryptography, Classical Cryptosystem, Block Cipher. Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher.

UNIT II :

LFSR based Stream Cipher, Mathematical background, Abstract algebra, Number Theory. Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem.

UNIT III :

Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem. Primarily Testing, ElGamal Cryptosystem, Elliptic Curve over the Reals, Elliptic curve Modulo a Prime.

UNIT IV :

Generalized ElGamal Public Key Cryptosystem, Rabin Cryptosystem. Message Authentication, Digital Signature, Key Management, Key Exchange, Hash Function

UNIT V:

Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS). Cryptanalysis, Time-Memory Trade-off Attack, Differential and Linear Cryptanalysis.

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UNIT VI:

Cryptanalysis on Stream Cipher, Modern Stream Ciphers, Shamir's secret sharing and BE, Identity-based Encryption (IBE), Attribute-based Encryption (ABE). Side-channel attack, The Secure Sockets Layer (SSL), Pretty Good Privacy (PGP), Introduction to Quantum Cryptography, Blockchain, Bitcoin and Cryptocurrency.

Text Books: Nil

	Title	Edition	Author	Publisher
1	Cryptography Theory And Practice	III Edition	Douglas R. Stinson	Chapman & Hall

Reference Book: Nil

	Title	Edition	Author	Publisher
1	Introduction to Modern Cryptography	Second edition, December 2014	KATZ	Taylor & Francis;

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7th Semester

EEHN21	Privacy & Security in Online Social Media			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme <i>*Best Two out of three MSE's would be considered</i>	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs

Prerequisites

Course Objective

Students should be able to

Course Outcome

Students will be able to

- 1) Appreciate various privacy and security concerns (spam, phishing, fraud nodes, identity theft) on Online Social Media
- 2) Clearly articulate one or two concerns comprehensively on one Online Social Media.

UNIT I :

What is Online Social Networks, data collection from social networks, challenges, opportunities, and pitfalls in online social networks, APIs

UNIT II : Collecting data from Online Social Media

UNIT III : Trust, credibility, and reputations in social systems

UNIT IV : Online social Media and Policing

UNIT V: Information privacy disclosure, revelation and its effects in OSM and online social networks

UNIT VI: Phishing in OSM & Identifying fraudulent entities in online social networks

Text Books: Nil

	Title	Edition	Author	Publisher
1	Security and Privacy in Social Networks	1 st Edition 2013	Altshuler, Y., Elovici, Y., Cremers, A.B., Aharony, N	Springer

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Reference Book: Nil

	Title	Edition	Author	Publisher
1	Security and Trust in Online Social Networks	1 st Edition 2014	Barbara Carminati Elena Ferrari , Marco Viviani	Morgan & Claypool Publishers

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7th Semester

EEHN22	Hardware Security			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme <i>*Best Two out of three MSE's would be considered</i>	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs
Prerequisites							
Course Objective Students should be able to			Course Outcome Students will be able to 1)Address different security threats on modern hardware design, manufacturing, installation and operating practices.				
UNIT I : Introduction, Finite Fields, AES Hardware, S-Box Algorithm to Hardware, Case Study on ECC, Introduction to ECC							
UNIT II : Implementation of ECC, Hardware Design of ECC, Introduction to Side Channel Analysis							
UNIT III : Advanced SCA, Introduction to Fault Attacks, Advanced Fault Attacks, Algebraic Fault Analysis							
UNIT IV : Countermeasures-I, Countermeasures-II							
UNIT V: Introduction to PUFs, Designs on FPGAs, Machine Learning of PUFs , Design-for-Testability for Cryptographic Designs							
UNIT VI: Protocols, Challenges, Introduction to Micro-architectural attacks, Advanced Micro-architectural attacks, Hardware monitoring for malwares using Hardware Performance Counters							

Text Books: Nil

	Title	Edition	Author	Publisher
1	Hardware Security: A Hands-on Learning Approach	1st Edition, Kindle Edition, October 2018	Swarup Bhunia Mark Tehranipoor	Morgan Kaufmann

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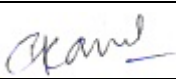

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Reference Book: Nil

	Title	Edition	Author	Publisher
1	Hardware Security: Design, Threats, and Safeguards	1st Edition	Rajat Subhra Chakraborty, Debdeep Mukhopadhyay	Chapman and Hall/CRC

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