SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

SYLLABUS

FOR

Doctor of Philosophy

School of Computer Application & Information Technology

(w.e.f. 2021-2022)

Program Outcomes

- Provide students with knowledge, general competence, and analytical skills in Research Methodology and Research & Publication Ethics.
- Build their foundation for research in Computer Science.
- Provide hands-on experience to carry out research work in Computer Science as well as interdisciplinary areas
- Offer expertise, resources, and services to the community.
- Knowledge and understanding of ethical standards in proposing, executing, and communicating scientific research.
- Ability to conduct independent research.
- Proficiency with fundamental knowledge in several specialized areas of research and expertise in at least one area of research
- Ability to communicate concepts and results to a technical audience in the form of conference papers, journal papers, and/or oral presentations

Programme Specific Outcomes

- Equip themselves with ethical issues related to Research and Publication.
- Build a strong foundation for future research work in a systematic manner by applying notions of Research Methodology
- Gain ability to apply knowledge of Computer Science to research in real-world issues.
- Get familiar with current research trends in various core areas of Computer Science like ANN,
- NLP, Cloud Computing, Digital Image Processing, Big Data, AI, Cryptography, Software Engineering etc.

S.No	**Course No.**	**Subject**	**Credit** **L:T:P**	**Total Credit**	**Total Marks**	**Minimum marks to be scored for successful completion**
1	PRMC101	Research Methodology	2:1:1	4	80	40
2	RPEC 102	Research Publication & Ethics		4	80	40
3	PCSC102	Subject Specific core		4	80	40
4	 PCSE103 PCSE104 PCSE105 PCSE106	Research Area Elective (Any one) Wireless Sensor Network Network Security Software Engineering Cloud Computing		4	80	40
5	PCSF107	Field work / Workshop /Seminar		4	80	40
				20	400	200

Course code : PRMC 101				
Course Name : Research Methodology				
Semester /Year :				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

- understand some basic concepts of research and its methodologies
- identify appropriate research topics
- select and define appropriate research problem and parameters
- organize and conduct research (advanced project) in a more appropriate manner

Course Contents

Unit I-Concept & Types of Research **01**

Meaning and importance of Research, Types of Research, Selection and formulation of Research Problem, Research Design, Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation research/Studies, Action Research, Experimental Research, Historical Research.

Unit II –Methods Research **01**

General Survey of various Methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free).

Unit III - Data Collection and Data Analysis **01**

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data, Primary, Secondary and Tertiary Data, Construction and adaptation of instruments, administration of questions and tests, Data organization in SPSS & Excel, Graphical representation of data, Testing of Hypothesis: Logical and Statistical Techniques.

Unit IV: Report Writing **01**

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

References:

1) Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.
2) Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.
3) Cooper, R. Donald and Pamela S. Schindler (2003) Business Research Methods, Delhi, Tata McGraw-Hill.
4) Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.
5) Goodde and Hatte (1952) Methods in Social Research, New York, McGraw – Hill.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To develop understanding of the basic framework of research process
CO2	To develop an understanding of various research designs and techniques.
CO3	To identify various sources of information for literature review and data collection.
CO4	To develop an understanding of the ethical dimensions of conducting applied research
CO5	Appreciate the components of scholarly writing and evaluate its quality

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	3	1	1						
CO2	2	2	2	2	1	1						
CO3	2	3	2	3	2	2						
CO4				2	2	2						
CO5												

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : RPEC-102				
Course Name : Research & Publication Ethics (Compulsory)				
Semester /Year :				
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

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

Course Contents

Unit I-Philosophy and Ethics **0.2**

Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition moral philosophy, nature of moral judgements and reactions.

Unit II-Scientific Conduct **0.3**

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification and Plagiarism (FFP), Redundant publication: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data.

Unit III-Publication Ethics **0.5**

Publication ethics: definition, introduction and importance, Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals Practice.

Unit IV-Open Access Publishing **0.25**

Open access publications and initiatives, SHERPA / RoMEO online resource to check publisher copyright and self-archiving policies, Software tools to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

Unit V-Publication Misconduct **0.25**

Group Discussion, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. Software tools, Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit VI-Databases and Research Metrics **0.5**

Databases, Indexing databases, Citation databases: Web of Science, scopus, etc., Research Metrics, Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score, Metrics: h-index, g index, i10 index, altmetrics.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To develop an understanding of research ethics, publications misconduct and plagiarism.
CO2	To develop Intellectual honesty and research integrity.
CO3	To identify various sources of information for data bases and research matrices.
CO4	To develop an understanding of Open access publications and initiatives.
CO5	Appreciate the components of scholarly writing and evaluate its quality

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	3	1	2	2	2							
CO3	2	2	2	2	2	2	2					
CO4	3	2	3	3	2	2						
CO5	2	2	3									

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: PCSC-102**			
Course Name	**: Applied Graph Theory, Algorithms and Statistical Methods**			
Semester /Year	**:**			
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

Course Objectives: The objectives of this course are

- To learn various types of graphs
- To learn spanning tree
- To learn greedy algorithms
- To learn Chi Square test and ANOVA test

Course Contents

Unit I: Graph Theory:-

Graph & applications of graph, Graph & its properties, representation of Graph, DFS & BFS Dijikstra algorithm. Tree & its properties, spanning tree, Minimum Spanning Tree , Prims Algorithm, Kruskal Algorithm, enumeration of graph, caley's Hamilton theorem.

Unit II: Designing and Analysis of Algorithms:

Algorithms, Analysis of Algorithms, Design of Algorithms, asymptotic notations , Complexity of Algorithms, Mathematical Analysis of Non-Recursive and Recursive Algorithms**.** Recurrences andSolution of Recurrence Equations, generating function. Divide and conquer, greedy algorithm.

Unit III: Statistical Estimation and Testing:

Tests of significant of attributes, Z-test of significance and Coefficient of correlation, Small sample test, T-test, Paired Test, F test of equality of variance, large sample test, Normal test.Non-Parametric Test: Chi-square test, ANOVA.

Unit IV: Modeling and simulation:

Introduction to Modelling & simulation. System simulation, Why to simulate and when to simulate, Basic nature of simulation, technique of simulation, comparison of simulation and analytical methods, types of system simulation, real time simulation, hybrid simulation, simulation of pure-pursuit problem single-server queuing system and an inventory problem, Monte Carlo simulation, Distributed Lag models, Cobweb model.

Books:

1. Statistics by T.R Jain & S C Aggarwal, VK (India) Enterprises, Darya Ganj (New Delhi).
2. Statistical Methods for Research: S. Singh et al (1988) Central Publishing Ludhiana.
3. Statistical Methods: S.P. Gupta. S. Chand Publication.
4. Averill M. Law, W. David Kelton, "Simulation Modeling and Analysis", TMH

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Understand different graph and properties
CO2	Design algorithm for analysis
CO3	Understand statistical estimation testing
CO4	Understand simulation and modeling
CO5	Understand cobweb model.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2		3	2	2	1	1	2					
CO3				2	2	1	2					
CO4				1	2	2	1					
CO5				1	1	2	1					

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: PCSC-103**
Course Name	**: Wireless Sensor Network**

Semester /Year :				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

Course Objectives: The objectives of this course are

- To understand the basics of Ad-hoc & Sensor Networks
- To learn various fundamental and emerging protocols of all layers.
- To understand the nature and applications of Ad-hoc and sensor networks.

Course Contents

UNIT-1: OVERVIEW OF WIRELESS SENSOR NETWORKS

Characteristic requirements –Tos, Qos, Fault tolerance, Lifetime ,scalability, wide range densities, programmability, maintainability. Required mechanisms – multihop, energy efficient, auto configuration, collaboration, data centric, locality, exploit trade-off. Unique constraints and challenges of sensor networks. Emerging technologies for wireless sensor networks. Advantagesof sensor networks – energy advantage – detection advantage.

UNIT-2: ARCHITECTURES

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes,Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.
Hardware components – communication device - sensors and actuators – power supply of sensor nodes Energy consumption of sensor nodes– operation states with different power consumption – microcontroller energy consumption– memory Energy consumption - Radio transceivers – computation and communication – power consumption. OS – Embedded OS – programming paradigms – protocol stack – energy and power management Network architecture – Sensor network scenarios – types of sources and sinks – single hop Vs multi hop-multiple sources and sinks – mobility. Optimization goals and figures of merit – Qos – energy efficiency – scalability – robustness. Hardware components – sensor node overview – controller-memory

UNIT 3: NETWORKING SENSORS

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless SensorNetworks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

Communication protocols – physical layer and transceiver design in WSN : energy usage profile –choice of modulation scheme. Communication protocols – physical layer and transceiver designin WSN : dynamic modulation scaling – antenna. MAC protocols - Low duty cycle protocols and wake up concepts : S-MAC. MAC protocols - Low duty cycle protocols and wake up concepts : Wakeup radio concepts .Naming and addressing

– Address and name management in WSN. Naming and addressing – Assignment of MAC addresses – distributed assignment of network wide addresses

UNIT-4: INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Topology control – motivation and basic ideas–options and aspects of topology- controlling topology in flat networks –power control. Clustering – hierarchical networks by clustering – clusters - connecting clusters – rotating cluster heads. Clustering – hierarchical networks by clustering –Multihop clusters – multilayer of clustering – passive clustering . Time synchronization – need – properties – protocol – LTS – TPSN – RBS – HRTS.Time synchronization – clocks and communication delays – interval methods – reference

broadcasts. Localization and positioning – properties – approaches – lateration problem – SingleHop localization

UNIT -5: SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

Sensor node hardware – Berkeley motes. Sensor network programming challenges. Node –Level software platforms – nesC-component implementation. Node –Level software platforms – nesC- concurrency and atomicity. Node –Level software platforms – TinyGALS. Node – Level simulators – ns2 simulator

Books:

1. Holger Kerl, Andreas Willig, "Protocols and Architectures for Wireless SensorNetwork", John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9)
2. Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, "Wireless SensorNetwork", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
3. Feng Zhao, Leonidas Guibas, " Wireless Sensor Network",Elsevier, 1st Ed. 2004(ISBN:13-978-1-55860-914-3)
4. Kazem, Sohraby, Daniel Minoli, Taieb Zanti, "Wireless Sensor Network: Technology,Protocols and Application", John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471- 74300-2).
5. B. Krishnamachari, " Networking Wireless Sensors", Cambridge University Press.
6. N. P. Mahalik, "Sensor Networks and Configuration: Fundamentals, Standards,Platforms, and Applications" Springer Verlag.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Understand wireless sensor networks

CO2	Understand single node architecture.
CO3	Design networking sensors
CO4	Understand infrastructure establishment .
CO5	Understand sensor networks platform

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : PCSC-104				
Course Name : Network Security				
Semester /Year :				
	L	**T**	**P**	**C**

	3	**1**	**0**	**4**

Course Objectives: The objectives of this course are

- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
- To understand various protocols for network security to protect against the threats in the networks

Course Contents

UNIT I: INTRODUCTION

Security Trends, Principles of security, Types of Security attacks, Active attacks, Passive Attacks,their comparison, Layers, Authorization, Viruses, Worms, Multilevel Model of Security, Legal Issues, Security services, Security Mechanisms, A model for Network Security.

UNIT II: CRYPTOGRAPHY

Cryptography, Encryption, Terminology, Basic Techniques, Secret Key Cryptography, Streamand Block Encryption, Data Encryption Standard (DES), Multiple Encryption DES, Blowfish, International Data Encryption Standard (IDEA), RC5, Advanced Encryption Standard (AES), Public Key Cryptography, RSA, Diffie Hellman, Hash Algorithms, Digital Signature, Steganography.

UNIT III: MODES OF OPERATION & FIREWALLS

Introduction, Encrypting a large message – Electronic Code Book (ECB) , Cipher Block Chaining (CBC), Output Feedback Block (OFB), Cipher Feedback Mode (CFB), Counter Modes CTR, Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Typesof Firewalls firewall, packet filers, application level gateways, disadvantages of firewall, denial ofservice attacks.

UNIT IV: AUTHENTICATION & WIRELESS/IP SECURITY

Introduction, Authentication basics, Passwords, Authentication Tokens, Certificate based Authentication, Biometric Authentication, Wireless Security, Mobile Device Security, IEEE

802.11 Wireless LAN concepts, IEEE 802.11i Wireless LAN Security, Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Web security considerations,HTTPS.

Books/References:

1. Kaufman Charlie**, "**Network Security**,"** Pearson Education**,** 2nd Ed**,** 2005
2. Schneier Bruce**, "**Applied Cryptography**,"** Wiley John**,** 2nd Ed**,** 2005

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Understand types of security attacks
CO2	Understand DES and AES encryptions.
CO3	Understand ECB and CBC
CO4	Define authentication methods
CO5	Define 802.11 wireless LAN concepts

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2								
CO2		2	2	2								
CO3		2	3	2								
CO4		2	2	1								
CO5				1								

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : PCSC-105				
Course Name : Software Engineering				
Semester /Year :				
	L	**T**	**P**	**C**

	3	**1**	**0**	**4**

Course Objectives: The objectives of this course are

- To provide the concepts of software crisis, issues, characteristics, evolution and application with respect to software engineering.
- To give fundamental aspects of software development with respect to requirement engineering, requirement analysis, design, coding, testing and maintenance.
- To give knowledge of practical implementation of software coding style and software testing strategies for software development.
- To provide the practical knowledge in software design, object oriented design and software development in terms of software implementation and maintenance

Course Contents

UNIT-I: INTRODUCTION:

Introduction to software engineering, Importance of software, The evolving role of software,Software Characteristics, Software Components, Software Applications, Software Crisis, Software engineering problems, Software Development Life Cycle, Software Process.

UNIT-II: SOFTWARE REQUIREMENT SPECIFICATION

Analysis Principles, Water Fall Model, The Incremental Model, Prototyping, Spiral Model, Role of management in software development, Role of matrices and Measurement, Problem Analysis, Requirement specification, Monitoring and Control.

Software-Design: Design principles, problem partitioning, abstraction, top down and bottom up-design, Structured approach, functional versus object oriented approach, design specifications and verification, Monitoring and control, Cohesiveness, coupling, Forth generation techniques, Functional independence, Software Architecture, Transaction and Transform Mapping, Component – level Design, Forth Generation Techniques

UNIT-III: CODING

Top-Down and Bottom –Up programming, structured programming, information hiding, programming style and internal documentation.

Testing: Testing principles, Levels of testing, functional testing, structural testing, test plane, test case specification, reliability assessment, software testing strategies, Verification & validation, Unit testing, Integration Testing, Alpha & Beta testing, system testing and debugging.

UNIT-IV: SOFTWARE PROJECT MANAGEMENT

The Management spectrum- (The people, the product, the process, the project), cost estimation, project scheduling, staffing, software configuration management, Structured Vs. Unstructured maintenance, quality assurance, project monitoring, risk management.

UNIT-V: SOFTWARE RELIABILITY & QUALITY ASSURANCE

Reliability issues, Reliability metrics, Reliability growth modeling, Software quality, ISO 9000 certification for software industry, SEI capability maturity model, comparison between ISO &SEI CMM.

CASE (Computer Aided Software Engineering): CASE and its Scope, CASE support in software life cycle, documentation, project management, internal interface, Reverse Software Engineering, Architecture of CASE environment.

References

1. Pressman, Roger S., "Software Engineering: A Practitioner's Approach Ed. Boston:McGraw Hill, 2001
2. Jalote, Pankaj, "Software Engineering Ed.2", New Delhi: Narosa 2002
3. Schaum's Series, "Software Engineering", TMH
4. Ghezzi, Carlo and Others, "Fundamentals of Software Engineering", PHI
5. Alexis, Leon and Mathews Leon, "Fundamental of Software Engineering".
6. Sommerville, Ian, "Software Engineering", AWL, 2000

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Understand software and its applications
CO2	Design software requirement specifications.
CO3	Understand different software models
CO4	Understand software and project management
CO5	Understand software reliability and quality.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1								
CO2	1	1	1	2								
CO3	1	2	1	2								
CO4	2	2	2	2								
CO5	2	2	2	1								

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : PCSC-106				
Course Name : Cloud Computing				
Semester /Year :				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

Course Objectives: The objectives of this course are

- Explain the various models and services of cloud
- Identify the technical foundations of cloud systems architectures.
- Analyze the problems and solutions to cloud application problems.
- Apply principles of best practice in cloud application design and management.
- Identify and define technical challenges for cloud applications and assess their Importance

Course Contents

UNIT I: CLOUD COMPUTING FUNDAMENTALS

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

UNIT II: CLOUD APPLICATIONS

Technologies and the processes required when deploying web services; Deploying a webservice from inside and outside a cloud architecture, advantages and disadvantages.

UNIT 3: MANAGEMENT OF CLOUD SERVICES

Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; CloudEconomics : Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

UNIT IV: APPLICATION DEVELOPMENT

Service creation environments to develop cloud based applications. Development environmentsfor service development; Amazon, Azure, Google App.

TEXT BOOKS:

1. GautamShroff, “Enterprise Cloud Computing Technology Architecture Applications”,Cambridge University Press; 1 edition.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”McGraw-Hill Osborne Media; 1 edition
3. Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 1 edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Understand distributed system .

CO2	Understand public, private, hybrid cloud
CO3	Understand cloud economics
CO4	Describe different clouds like amazon etc.
CO5	Understand clouds applications

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	3	3	2	2	2	2	
CO2	2	2				1	1	1	1	2	2	
CO3						1						
CO4						2						
CO5						2	2	2	2	3	1	

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated