Detailed syllabus of semester – II

Course Code	Course Title	Credits
TPGCS201	Advanced Operating Systems	04

Course Objective:
- Understanding advanced Operating System concepts
- Working with real time operating Systems
- Understanding working of multiprocessor operating systems
- Understanding working of current Operating systems and other trends in Operating Systems

Expected Learning Outcome:
Learners completing this course will be able to:
- Understanding various types of modern Operating systems
- Working with real time & cluster

Unit I: Process Synchronization

Overview, Synchronization Mechanisms, Process Deadlocks, .Distributed Operating Systems: Architectures of Distributed Systems, Theoretical Foundations, Distributed Mutual Exclusion, Distributed Deadlock Detection, Agreement Protocols Distributed Resource Management: Distributed File Systems, Distributed Share Memory, Distributed Scheduling

Unit II: Failure Recovery

Failure Recovery and Fault Tolerance, Recovery, Fault Tolerance. Protection and Security, Resource Security and Protection Access and Flow Control, Data Security Cryptography

Unit III: Multiprocessor Operating System and Database Operating System

Multiprocessor Operating Systems: Multiprocessor System Architectures, Multiprocessor Hardware, Multiprocessor Synchronization, Multiprocessor Scheduling
Database Operating Systems: Introduction to Database Operating Systems, Concurrency Control Theoretical Aspects

Unit IV: System Recovery and Android Operating System

System Recovery, Real Time and Multimedia Operating system Lightweight Recoverable Virtual Memory, Rio Vista, Quicksilver
Internet Scale Computing, Giant Scale Services, MapReduce, Content Delivery

Networks.
Real-Time and Multimedia, Time sensitive Linux, Persistent temporal streams

Text book:
- Mukesh Singhal, Niranjan G.Shivaratri, Advanced Concepts In Operating Systems, TMH, 2008,
- Pramod Chandra P. Bhatt, An Introduction to Operating Systems: Concepts and Practice (GNU/Linux), 4th edition, Prentice-Hall of India Pvt. Ltd, 2014.
- Avi Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts with Java Eight Edition, John Wiley & Sons, Inc., 2009, http://codex.cs.yale.edu/avi/os-book/OS8/os8j

References:
- Andrew S. Tanenbaum, Albert S. Woodhull, Operating Systems: Design and Implementation, Third Edition, Prentice Hall, 2006.

Course Code	Course Title	Credits
TPGCS202	Design and implementation of Modern Compilers	04

Course Objective:
- Understanding working of System Software
- Implementation of Complier
- Understanding new techniques in compliers and design

Expected Learning Outcome:
Learners completing this course will be able to:
- Working with system software
- Developing trivial compiler

Unit I: Introduction to Compilers

The structure of a compiler, A simple approach to the design of lexical analyzers, Regular expressions, Finite automata, From regular expressions to finite automata, Minimizing the number of states of a DFA, Context-free grammars, Derivations and Parse trees, Parsers, Shift-reduce parsing, Operator-precedence parsing, Top- down parsing, Predictive parsers.

Unit II: Automatic Construction of Efficient Parsers

LR parsers, The canonical collection of LR(0) items, Constructing SLR parsing tables, Constructing canonical LR parsing tables, Constructing LALR parsing tables, Using ambiguous grammars, An automatic parser generator, Implementation of LR parsing tables, Constructing LALR sets of items.

Unit III: Advanced syntax analysis and basic semantic analysis

Syntax-directed translation schemes, Implementation of syntax-directed translators: Dependency Graphs; S-Attributed Definitions; L-Attributed Definitions; Translation Schemes, Semantic Analysis: Type Checking; Type System; Specifying a Type Checker; Type Conversion

Unit IV: Dataflow analysis and loop optimization

The principle sources of optimization, Loop optimization: The DAG representation of basic blocks, Dominators, Reducible flow graphs, Depth-first search, Loop-invariant computations, Induction variable elimination, Some other loop optimizations. Dataflow Analysis: intermediate representation for flow analysis, various dataflow analyses, transformations using dataflow analysis, speeding up dataflow analysis, alias analysis.

Text book:
- Alfred V. Aho , Monica S. Lam , Ravi Sethi , Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Pearson, 2nd edition, 2011
- Andrew Appel and Jens Palsberg, Modern Compiler Implementation in Java, Cambridge University Press, Second Edition, 2004

References:
- Kenneth C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997
- Alfred Aho and Jeffrey D. Ullman, Principles of Compiler Design, Addison Wesley, 1997

Course Code	Course Title	Credits
TPGCS2031	Elective I - Track A: Cloud Computing (Concepts and Design of Web services)	04

Course Objective:
- Working cloud architecture and designing solutions
- Understating the SOA
- Working SOAP

Expected Learning Outcome:
Learners completing this course will be able to:
- Launching web services on cloud
- Understand and implement of SOA

Unit I: Web Service as distributed application

The Service Endpoint Interface (SEI) and Service Implementation Bean (SIB), JAX-WS, Publishing Web Service, Calling Web Service from applications developed in different platform, SOAP, Message transport, Service contract, Web Services returning Richer Data types, Multithreading the Endpoint Publisher, WSDL structure.

Unit II: SOAP Based Web Services

Structure of SOAP Message (In JAX-WS), SOAP Messaging Architecture, SOAP Header, Client-side SOAP Handler, Generating a Fault, Service-side SOAP Handler, Handler methods, Message Context and Transport Headers, Web Services and Binary Data.

Unit III: REST-style Web Services

What is REST? HTTP methods, Java API for RESTful Web Services (JAX-RS), JAX-RS with Jersey, CRUD RESTful Web Service, SOAP and REST in Harmony, Interoperability between the Java Platform and WCF, WSIT, Web Services Security, Wire-Level Security, Container-Managed Security for Web Services, WS-Security.

Unit IV: Amazon Web Services (AWS) Essentials

Architecting on AWS, Building complex solutions with Amazon Virtual Private Cloud (Amazon VPC), Leverage bootstrapping and auto configuration in designs, Architect solutions with multiple regions, Employ Auto Scaling design patterns, Amazon

CloudFront for caching, Big data services including AWS Data Pipeline, Amazon Redshift and Amazon Elastic MapReduce. Plan for application management services including AWS Elastic Beanstalk and AWS OpsWorks, Improve security with AWS Identity and Access Management (IAM).

Text book:

- Martin Kalin , Java Web Services Up and Running, O'Reilly, 2009
- Brian Beach, Pro Power Shell for Amazon Web Services, Apress, 2014.

Reference:

- Jurg van Vliet, Flavia Paganelli, Programming Amazon EC2, O'Reilly Media, 2011.
- Eric Jendrock, Ricardo Cervera-Navarro, Ian Evans, Devika Gollapudi, Kim Haase, William Markito, Chinmayee Srivathsa, The Java EE 6 Tutorial (Part III Web Services), Jan 2013, http://docs.oracle.com/javaee/6/tutorial/doc/bnayk.html.
- JAX-WS Reference Implementation (RI) Project, https://jax-ws.java.net/.
- Java API for RESTful Services (JAX-RS), https://jax-rs-spec.java.net/.
- RESTful Web Services in Java, https://jersey.java.net/.
- AWS Training, http://aws.amazon.com/training.

Course Code	Course Title	Credits
TPGCS2032	Elective I - Track B: Cyber and Information Security (Network and Communication Security)	04

Course Objective:

- Computer Security protocols
- Understanding networking security
- Understanding cloud security

Expected Learning Outcome:

Learners completing this course will be able to:

- Working with mobile and cloud security
- Developing application to understand computer and network security

Unit I: Computer Security

Principles of Security, Different Attacks: malicious and non-malicious program, Types of Computer Criminals. Operating System Security: Protected objects and methods of

protection. Memory address protection: Fence, Relocation, Base/Bound Registers, Tagged Architecture, Segmentation, Paging, Directory, access control list. Database Security: Security requirements, Integrity, Confidentiality, Availability, Reliability of Database, Sensitive data, Multilevel database, Proposals for multilevel security. .

Unit II: Network Security

Different types of network layer attacks, Firewall (ACL, Packet Filtering, DMZ, Alerts and Audit Trials) – IDS,IPS and its types (Signature based, Anomaly based, Policy based, Honeypot based). Web Server Security: SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET), Kerberos.

Unit III: Cloud Security

How concepts of Security apply in the cloud, User authentication in the cloud; How the cloud provider can provide this- Virtualization System Security Issues: e.g. ESX and ESXi Security, ESX file system security- storage considerations, backup and recovery-Virtualization System Vulnerabilities, security management standards- SaaS, PaaS, IaaS availability management- access control- Data security and storage in cloud.

Unit IV: Mobile Security:

Mobile system architectures, Overview of mobile cellular systems, GSM and UMTS Security & Attacks, Vulnerabilities in Cellular Services, Cellular Jamming Attacks & Mitigation, Security in Cellular VoIP Services, Mobile application security. Securing Wireless Networks: Overview of Wireless Networks, Scanning and Enumerating 802.11 Networks, Attacking 802.11 Networks, Bluetooth Scanning and Reconnaissance, Bluetooth Eavesdropping, Attacking and Exploiting Bluetooth, Zigbee Security, Zigbee Attacks.

Text book:

- Charles P. Pfleeger, Charles P. Pfleeger, Shari Lawrence Pfleeger, Security in Computing 4th edition, Prentice Hall; 4th edition, 2006
- Kia Makki, Peter Reiher, Mobile and Wireless Security and Privacy, Springer, 2007

- Tim Mather, Subra Kumaraswamy, Shahed Latif , Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory and practice), O'Reilly Media; 1 edition, 2009

Reference:

- Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley, 2010
- Charlie Kaufman, Radia Perlam, Mike Speciner, Network Security, Prentice Hall, 2nd Edition, 2002
- Atul Kahate, Cryptography and Network Security 3rd edition, Tata McGraw Hill Education Private Limited, 2013
- Charlie Kaufman, Radia Perlam, Mike Speciner, Network Security, Prentice Hall, 2nd Edition, 2002
- William Stallings, Cryptography and Network Security: Principles and practice 6th edition, Pearson Education, 2013

Course Code	Course Title	Credits
TPGCS2041	Elective II - Track C: Business Intelligence and Big Data Analysis (Business Intelligence)	04

Course Objective:

- Understanding Business Intelligence
- Understanding OLTP and OLAP
- Understanding Data warehousing and mining

Expected Learning Outcome:

Learners completing this course will be able to:

- Developing and understanding business intelligence systems
- Working data warehousing and mining for DSS

Unit I: Introduction to Business Intelligence

Operational and Decision Support System, Data-Information-Knowledge-Decision making-Action cycle. Basic definitions- Business Intelligence; Data warehousing, Business Intelligence architecture, Use and benefits of Business Intelligence.

Knowledge Discovery in Databases: KDD process model, Data Pre-processing: Cleaning: Missing Values; Noisy Values; Inconsistent values; redundant values. Outliers, Integration, transformation, reduction, Discretization: Equal Width Binning; Equal Depth Binning, Normalization, Smoothing.

Unit II: Introduction to Business Data Warehouse

Definition of Data warehouse, Logical architecture of Data Warehouse, Data Warehouse model- Enterprise warehouse; Data Marts; Virtual warehouse. Populating business Data Warehousing: data integration and extract, transform, load (ETL).

Unit III: Designing business Data Warehouse

OLTP and OLAP systems, Designing business information warehouse: Principles of dimensional modeling, Data cubes, Data cube operations, data cube schemas.

Unit IV: Introduction to Data Mining

Data mining definitions and process: business and data understanding. Association Analysis: Definition of association rule, General issues: Support; Confidence; Lift; Conviction, Frequent Item sets: APriori Algorithm; Issues with APriori Algorithm, Data structures: Hash tree and FP tree.

Text book:

- Efraim Turban, Ramesh Sharda, Dursun Delen, David King, Business Intelligence (2nd Edition), Pearson
- Swain Scheps, Business Intelligence for Dummies, Wiley Publications
- Inmon B., Building the Data Warehouse, Wiley, 1993
- Dunham, Margaret H, Introductory and Advanced Topics - Data Mining: Prentice Hall
- Ian and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann

Reference:

- Larissa T. Moss, Shaku Atr, Business Intelligence Road Map, Addison-Wesley
- Chuck Ballard, Dirk Herreman, Don Schau, Rhonda Bell, Eunsaeng Kim, Ann Valencic, Data Modeling Techniques for Data Warehousing by IBM; International

Technical Support Organization, http://www.redbooks.ibm.com
- Han J. and Kamber M., Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann Publishers, 2000
- MacLennan Jamie, Tang ZhaoHui and Crivat Bogdan, Data Mining with Microsoft SQL Server 2008, Wiley India Edition (2009)

Course Code	Course Title	Credits
TPGCS2042	Elective II - Track D: Machine Learning (Fundamentals of Machine Learning)	04

Course Objective:

- Understanding various learning strategies
- Mathematical representation of Machine learning problems and solutions

Expected Learning Outcome:

Learners completing this course will be able to:

- Machine learning using linear methods and nonlinear methods
- Developing machine learning architectures for clustering

Unit I: Learning-Standard Linear methods

Statistical Learning: What Is Statistical Learning, Assessing Model Accuracy. Linear Regression: Simple Linear Regression, Estimating the Coefficients, Assessing the Accuracy of the Coefficient, Estimates: Assessing the Accuracy of the Model. Multiple Linear Regressions: Estimating the Regression Coefficients, Some Important Questions, Other Considerations in the Regression Model, Qualitative Predictors, Extensions of the Linear Model, Potential Problems, The Marketing Plan, Comparison of Linear Regression with K-Nearest Neighbors. Classification: An Overview of Classification, Why Not Linear Regression? , Logistic Regression, The Logistic Model , Estimating the Regression Coefficients. Making Predictions, Multiple Logistic Regression, Logistic Regression for >2 Response Classes, Linear Discriminant Analysis, Using Bayes' Theorem for Classification, Linear Discriminant Analysis for p=1, Linear Discriminant Analysis for p >1 ,Quadratic Discriminant Analysis ,A Comparison of

Classification Methods.

Unit II: Selection and improvements of linear learning methods

Resampling Methods: Cross-Validation, The Validation Set Approach, Leave-One-Out Cross-Validation,k-Fold Cross-Validation ,Bias-Variance Trade-Off for k-Fold, Cross-Validation , Cross-Validation on Classification Problems The Bootstrap. Linear Model Selection and Regularization: Subset Selection, Best Subset Selection, Stepwise Selection, Choosing the Optimal Model. Shrinkage Methods: Ridge Regression, The Lasso, Selecting the Tuning Parameter. Dimension Reduction Methods: Principal Components Regression ,Partial Least Squares ,Considerations in High Dimensions ,High-Dimensional Data, What Goes Wrong in High Dimensions? Regression in High Dimensions, Interpreting Results in High Dimensions.

Unit III: Non-Linear Learning methods

Polynomial Regression, Basis Functions, Regression Splines, Piecewise Polynomials, Constraints and Splines, The Spline Basis Representation, Choosing the Number and Locations. of the Knots, Comparison to Polynomial Regression . Smoothing Splines: An Overview, Choosing the Smoothing Parameter λ .Local Regression, Generalized Additive Models: GAMs for Regression Problems, GAMs for Classification Problems. Tree-Based Methods: The Basics of Decision Trees, Regression Trees, Classification Trees Versus Linear Models, Advantages and Disadvantages of Trees. Bagging, Random Forests, Boosting: Bagging, Random Forests, Boosting.

Unit IV: Support Vector machines, Principle Component Analysis and Clustering

Support Vector Machines: Maximal Margin Classifier: What Is a Hyper plane?, Classification Using a Separating Hyper plane, The Maximal Margin Classifier, Construction of the Maximal Margin Classifier , The Non-separable Case. Support Vector Classifiers: Overview of the Support Vector Classifier, Details of the Support Vector, Support Vector Machines: Classification with Non-linear Decision Boundaries, The Support Vector Machine: An Application to the Heart Disease Data . SVMs with More than Two Classes : One-Versus-One Classification, One-Versus-All Classification .Relationship to Logistic Regression. Unsupervised Learning: The Challenge of

Unsupervised Learning, Principal Components Analysis: What Are Principal Components? , Another Interpretation of Principal Components, More on PCA, Other Uses for Principal Components. Clustering Methods: K-Means Clustering, Hierarchical Clustering, Practical Issues in Clustering.

Text book:

- Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in, Springer 2013
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer, Second Edition, 2008

Reference:

- Ethem Alpaydın, Introduction to Machine Learning, The MIT Press, Second Edition, 2010
- Christopher M. Bishop, Pattern Recognition and Machine Learning: Springer, 2006
- David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press 2012
- Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, 2012
- Drew Conway and John Myles White, Machine Learning for Hackers, O'Reilly, 2012
- Peter Harrington, Machine Learning in Action, Manning Publications, 2012
- Brett Lantz, Machine Learning with R, Packt Publishing, 2013
- https://class.coursera.org/ml-005/lecture/preview
- https://github.com/josephmisiti/awesome-machine-learning.

List of Practical Experiments for Semester –II

Course Code	Course Title	Credits
TPGCSP201	Practical Course on Advanced Operating Systems & Design and implementation of Modern Compilers	04

Sr No	List of Practical Experiments on Advanced Operating Systems
1	Demonstrate synchronization mechanism in process management using threads
2	Demonstrate Symmetric and Asymmetric Cryptography using Java technology
3	Use Hybrid encryption method in Java.
4	Implement mutual exclusion based algorithms a) Decker's algorithm b) Lamport algorithm c) Perterson's algorithm
5	Implementation of failure recovery by method of graceful degradation (fail soft)
6	Implement fault tolerance using Ring management protocol on multiple nodes.
7	Demonstrate concurrency management with database operating.
8	Implement multimedia server with different multimedia Files. Develop client to add/update/delete these files.
9	Demonstrate internet scale computing using any Operating System.
10	Demonstrate cluster computing system using Java technology
	List of Experiments on Design and implementation of Modern Compilers
1	Write a program to accept a string and validate using NFA.
2	Write a program to minimize given DFA.
3	Write a program to construct DFA using given regular expression.
4	Write a program to construct NFA from given regular expression.
5	Write a program to check the syntax of looping statements in C language
6	Write a program to illustrate the generation on SPM for the input grammar.
7	Write a program to illustrate the generation on OPM for the input operator

	grammar.
8	Implement a simple program analyzer and interpreter for the straight-line programming language.
9	Write a code to generate the DAG for the input arithmetic expression.
10	Write a program to demonstrate loop unrolling and loop splitting for the given code sequence containing loop.

Course Code	Course Title	Credits
TPGCSP202	Practical Course on Elective I and Elective II	04
Sr No	List or Practical Experiments on Elective I-Track A Cloud Computing (Concepts and Design of Web services)	
1	Develop Time Server service that returns current time in Java and call it from clients developed in Java, PHP, Android and .NET.	
2	Develop Web service in Java that returns complex data types (e.g. as List of friends).	
3	Develop Web service in Java that returns matrix multiplication by Strassen's algorithm. Two matrices will be entered at run time by client. Server does the matrix multiplication and returns answer to client.	
4	Demonstrate CRUD operations with suitable database using SOAP or RESTful Web service.	
5	Develop Micro-blogger application (like Twitter) using RESTful Web services.	
6	Develop application to consume Google's search / Google's Map RESTful Web service.	
7	Develop WCF service returning response in JSON type.	
8	Develop and demonstrate WCF service having multiple endpoints.	
9	Develop application to download image/video from server or upload image/video to server using MTOM techniques.	
10	Using AWS Flow Framework develop application that includes a simple workflow. Workflow calls an activity to print hello world to the console. It must define the	

	basic usage of AWS Flow Framework, including defining contracts, implementation of activities and workflow coordination logic and worker programs to host them.
11	Using AWS Flow Framework develop application, 'Booking' for making a reservation, including flight and rental car.
12	Demonstrates how to make basic requests to Amazon DynamoDB including: how to create a DynamoDB table with an LSI and GSI that can be accessed via a combination of hash keys and range keys. • how to add items to a table • how to get items from a table • how to query items on a table • how to scan items from a table using a filter expression • how to update items on a table • how to get items from a table in a batch • how to write items to a table in a batch • how to delete a table
Note: The following software is required for conducting the above experiments. • OS: Linux OS Ubuntu® 14.04 (use 64 bit) / Windows 7 (64 bit) • JDK 1.8 • LAMP/WAMP Server • AWS SDK for Java • Microsoft Visual Studio 10 • Android Studio.	
List of Practical Experiments on Elective I-Track B: Cyber &Information Security (Network & Comm. Security)	
1	Write a program to store username and password in an encrypted form in a database to implement integrity lock.
2	Write SQL query to retrieve sensitive information from less sensitive queries
3	Write SQL query to create a view to implement concept of views and commutative

	filter in distributed databases.
4	Write a program to implement SSL.
5	Write a program to send an encrypted email.
6	Write a program to digitally sign MIME to create an 'opaque' signature.
7	Write a program to generate DSA SSH key.
8	Write a program to implement multilevel security.
9	Write a program to Demonstrates how to encrypt and decrypt the content of an XML node using 128-bit CBC AES encryption.
	List of Practical Experiments on Elective II -Track C Bus. Intell. & Big Data analysis (Business Intelligence)
1	Do data preprocessing on data obtained from databases imported from external sources.
2	Develop an application to implement defining subject areas, design of fact and dimension tables, data marts
3	Develop an application to implement OLAP, roll-up, drill-down, slice, and dice operations.
4	Develop an application to construct a multidimensional data.
5	Design and create cube by identifying measures and dimensions for star schema
6	Design and create cube by identifying measures and dimensions for snow flake schema.
7	Process cube and browse cube data: By replacing a dimension in the grid, filtering and drilldown using cube browser. Browser dimension data and view dimension members, number properties, member properties values. Create calculated member using arithmetic operators and member property of dimension members.
8	Create and uses excel pivot table report based on data cube
9	Develop an application to demonstrate association analysis
10	Develop an application to demonstrate sequence analysis

	List of Practical Experiments on Elective II -Track D Machine Intelligence (Fundamentals of Machine Intelligence)
1	Implement simple linear regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Boston, Auto etc]
2	Implement multiple regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Carseats, Boston etc].
3	Fit a classification model using following: (i) logistic regression (ii) Linear Discriminant Analysis (LDA) and (iii) Quadratic Discriminant Analysis (QDA) on a standard data set and compares the results. [Inbuilt datasets like Smarket, Weekly, Auto, Boston etc may be used for the purpose].
4	Fit a classification model using K Nearest Neighbour (KNN) Algorithm on a given data set. [One may use data sets like Caravan, Smarket, Weekly, Auto and Boston].
5	Use bootstrap to give an estimate of a given statistic. [Datasets like Auto, Portfolio and Boston etc may be used for the purpose].
6	For a given data set, split the data into two training and testing and fit the following on the training set: (i) Linear model using least squares (ii) Ridge regression model (iii) Lasso model (iv) PCR model (v) PLS model Report test errors obtained in each case and compare the results. [Data sets like College, Boston etc may be used for the purpose].
7	For a given data set, perform the following: (i) Perform the polynomial regression and make a plot of the resulting

	polynomial fit to the data. (ii) Fit a step function and perform cross validation to choose the optimal number of cuts. Make a plot of the fit to the data. [Use data set like Wage for the purpose].
8	For a given data set, do the following: (i) Fit a classification tree (ii) Fit a regression tree [One may choose data sets like Carseats, Boston etc for the purpose].
9	For a given data set, split the dataset into training and testing. Fit the following models on the training set and evaluate the performance on the test set: (i) Boosting (ii) Bagging (iii) Random Forest [Data sets like Boston may be used for the purpose].
10	Fit a support vector classifier for a given data set. [Data sets like Car, Khan, Boston etc may be used for the purpose].
11	Perform the following on a given data set: (i) Principal Component Analysis (ii) Hierarchical clustering. [Data set like NC160, USArrests etc may be used for the purpose].
Note: The above practical experiments require the R Software	

Scheme of Examination for Theory Courses

There will be an internal and external examination for the theory courses. The weightage of internal/external and scheme of examination will be as per common guidelines provided by the University for the PG courses in the faculty of Science.

Scheme of Examination for Practical Courses

There will not be any internal examination for practical courses.

External Examination for practical courses:

The particulars of the external l examination for each practical course are given below:

Sr No	Semester	Course Code	Particular	No of questions	Marks/ question	Total Marks
1	I	TPGCSP101	Laboratory experiment question with internal choice	2	40	80
2			Journal	2	5	10
3			Viva	2	5	10
		Total Marks		100		
1	I	TPGCSP102	Laboratory experiment question with internal choice	2	40	80
2			Journal	2	5	10
3			Viva	2	5	10
		Total Marks		100		

Sr No	Semester	Course Code	Particular	No of questions	Marks/ question	Total Marks
1	II	TPGCSP201	Laboratory experiment question with internal choice	2	40	80
2			Journal	2	5	10
3			Viva	2	5	10
		Total Marks		100		
1	II	TPGCSP202	Laboratory experiment question with internal choice	2	30	60
2			Journal	2	5	10
3			Viva	2	5	10
4			Evaluation of Mini Project	1	20	20
		Total Marks		100		

Guidelines for Mini Project in the Semester–II

The syllabus proposes introduction of a mini project to be done by learners in the semester –II. The objective of this step is to make learning more learner-centric and to create a sense of involvement. **Learner can choose any topic related to one of the elective courses chosen by him or her.** Common Project Management techniques will be used for completing project. The mini project can be taken by learners individually or as a group of two.

- The efforts for the mini project should be spread over a period of at least 8 weeks.
- The mini project should cover a topic related to the one of the electives chosen by the learner.
- Learner should make a mini project report of around 20-25 pages (including good literature review) and submit during the practical examination.
- A presentation and viva based on the mini project will be undertaken during the practical examination.

Guidelines for maintenance of journals:

A student should maintain e-Journal with at least eight practical experiments reported for each of the subject. Related theory/algorithm need to be explained in journal. (Certified e-Journal [soft copy] is compulsory for appearing at the time of Practical Exam) Student has to upload the corrected document of each experiment to cloud within the time period assign by individual faculty.

Scheme of Internal Examination for Theory Courses - 40 Marks per paper

(i) CE-I 20 Marks - Duration 40 mins

It will be conducted either using any open source learning management system such as Moodle or equivalent.

(ii) CE-II 10 Marks – For completing NPTEL (Swayam), Coursera, Udemy, edX online courses (Learners must submit the certificate of the course)
Or
Presenting research paper in National or International Conference (Certificate is required)
Or
Publishing a research paper in National or International Journals (Certificate is required)

(iii)10 Marks - Active participation in routine class instructional deliveries
Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.