PUNJABI UNIVERSITY, PATIALA

SYLLABI
OUTLINES OF TESTS,
AND COURSES OF READINGS

FOR

M. TECH. (COMPUTER SCIENCE AND ENGINEERING)

SECOND YEAR

(SEMESTER THIRD AND SEMESTER FOURTH)

Session 2019-20

CHOICE-BASED CREDIT SYSTEM

(As per RUSA Guidelines)

PUNJABI UNIVERSITY,
PATIALA 147002

M. TECH. (COMPUTER SCIENCE AND ENGINEERING)
SECOND YEAR - THIRD SEMESTER
SESSION 2019-2020

Paper Code	Title of Paper	L	T	P	C	Internal Marks		External Marks	
						Max	Pass	Max	Pass
CS-711	Network Security	5	0	0	5	50	20	50	20
CS-712	Software Engineering	5	0	0	5	50	20	50	20
CS-713	Digital Image Processing	5	0	0	5	50	20	50	20
CS-714	*Elective	5	0	0	5	50	20	50	20
CS-715	Software Lab – III (Digital Image Processing)	0	0	6	3	60	24	40	16
CS-716	**Research Project	0	0	0	0	0	0	0	0
	Total	20	0	6	23	260		240	

***List of Electives:** Any one of the following papers:

Paper Code	Title of Paper
CS-714 E1	Pattern Recognition
CS-714 E2	Object Oriented Analysis and Design using UML
CS-714 E3	Neural Networks and Fuzzy Logic
CS-714 E4	Natural Language Processing
CS-714 E5	Machine Learning
CS-714 E6	Mobile Communication

***Note:** Depending upon the availability of the teachers, the electives will be offered to the students. The decision of the Head of the Department in this respect will be final.

**For CS-716: Research Project, there will not be any internal or university examination. This is a non-credit paper. There will not be any marks for the Research Project.

CONTINUOUS ASSESSMENT (THEORY PAPERS)

1.	Two tests will be conducted during the Semester. Both the tests will be considered for assessment.	:	60% of the marks allotted for Continuous Assessment
2.	Assignment/Quizzes	:	20% of the marks allotted for Continuous Assessment
3.	Attendance	:	10% of the marks allotted for Continuous Assessment.
4.	Class Participation and behavior	:	10% of the marks allotted for Continuous Assessment.

CONTINUOUS ASSESSMENT (PRACTICAL LAB)

1.	Two tests will be conducted during the Semester. Both the tests will be considered for assessment.	:	60% of the marks allotted for Continuous Assessment
2.	Lab Assignment	:	30% of the marks allotted for Continuous Assessment
3.	Attendance	:	10% of the marks allotted for Continuous Assessment.

M. TECH. (COMPUTER SCIENCE AND ENGINEERING)

SECOND YEAR – FOURTH SEMESTER
Session2019-2020

Paper Code	Title of Paper	L	T	P	C	External Marks	
						Max	Pass
CS-801	Dissertation	0	0	0	21	400	160
	Total	0	0	0	21	400	

Note: There will not be any marks for internal assessment of the students.

L T P C
5 0 0 5

CS-711: NETWORK SECURITY

Maximum Marks: 50 | **Maximum Time: 3 Hrs.**
Minimum Pass Marks: 40% | **Lectures to be delivered: 50-60**

Course Objective: This course is designed to explore the basic concepts in computer security including software vulnerability analysis and defence, networking and wireless security, applied cryptography, as well as ethical, legal, social and economic facets of security. Students will also learn the fundamental methodology for how to design and analyze security critical systems. Use different data types, operators and console I/O function in a computer program. Upon completion of this course students will be able to:

- Have internalized the fundamental notions of threat, vulnerability, attack and countermeasure.
- Have a theoretical understanding of the principles underlying cryptography and cryptanalysis and have a technical understanding of the main cryptographic concepts and technologies available today, including symmetric and asymmetric encryption, hashing, and digital signatures.
- Balance their knowledge of attack and defence mechanisms against the ethical and social norms of society, and act responsibly.

Course Content

SECTION A

Introduction: Attacks, Services and Mechanisms, Security attacks, security services, model for internetwork security.
Conventional Encryption: Conventional Encryption Model, Steganography.
Classical Encryption Techniques: Substitution Techniques, Transposition Techniques.

Modern Encryption Techniques: Simplified Data Encryption Standard, Block Cipher Principles, the Data Encryption Standard, Strength of DES.
Encryption Algorithms: Triple DES, International Data Encryption Algorithm, Blowfish.

SECTION B

Confidentiality using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key distribution, Random Number Generation.
Public- Key Cryptography: Principles of Public- Key Cryptosystems, RSA algorithm, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.

Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of hash Functions and MACs.
Digital Signatures, Authentication Protocols, SHA-1, RC-4, RC-5.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education.
- A.S.Tanenbaum, "Computer Networks", Pearson Education.
- C. Kaufman, R. Perlman, M. Speciner, "Network Security", Pearson Education.

Scheme of Examination

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.

L T P C
5 0 0 5

CS-712: SOFTWARE ENGINEERING

Maximum Marks: 50 | **Maximum Time: 3 Hrs.**
Minimum Pass Marks: 40% | **Lectures to be delivered: 50-60**

Course Objective: The main objective of this course is to provide broad understanding of the discipline of software engineering and its application to the development of and management of software systems. At the end of the course, the students will have:

- Knowledge of basic SW engineering methods and practices, and their appropriate application;
- A general understanding of software process models such as the waterfall and evolutionary models.
- An understanding of the role of project management including planning, scheduling, risk management, etc.
- An understanding of software requirements and the SRS document.
- An understanding of different software architectural styles.
- An understanding of implementation issues such as modularity and coding standards.
- An understanding of approaches to verification and validation including static analysis, and reviews.
- An understanding of software testing approaches such as unit testing and integration testing.
- An understanding of software evolution and related issues such as version management.
- An understanding on quality control and how to ensure good quality software.
- An understanding of some ethical and professional issues that is important for software engineers.
- Understanding of significance of teamwork and project based learning

Course Content

SECTION A

Introduction to S/W Engineering: Software Characteristics, Components, Layered Technology, Software Process, Process Model, Linear Sequential, Prototyping, RAID, Evolutionary Software Process Models.
Project Management : The Management Spectrum, Team Structures. Software Process and Project Metrics: Metrics in Process and Project Domain, Size-Oriented Metric, Function-Oriented Metrics, Metrics for Software Quality. An overview of Risk Analysis and Management.

Requirements Analysis: Analysis Principles**,** Specification. Analysis Modeling: Data Modeling, Functional Modeling, Behavioural Modeling.
Software Design: Design Process, Concepts, Principles, Architectural Design, Data Design, Mapping requirements into software Architecture, Structured Design Methodology, OO Design Methodology.
Implementation: Programming Standards and Procedures, Programming Practices, Code Verification Techniques.
User Interface: Principles, Design Issues.

SECTION B

Testing: Testing Objectives, Principles, White Box Testing, Black-Box Testing, Testing Strategies: Unit Testing, Integration Validation testing, System Testing. Automated System Testing, Automated Testing Tools, Legacy Systems
Client/Server Software Engineering: Architecture Design for C/S Systems, S/W Components for C/S Systems Database Design.

Object-Oriented Software Engineering: Object-Oriented Analysis: Domain Analysis, OOA process, Object Design process, OO testing Strategies, Metrics for OO Design, Metrics for OO Testing.
Reengineering: Software Reengineering, Reverse Engineering- Reverse Engineering to understand Processing, Data, Interface CASE, Building blocks for CASE, CASE tools.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Roger, S. Pressman, "S/W Engineering: A Practitioner's Approach ", McGraw Hills.
- Shari Lawrence PF Legger, S/X Engineering Theory and Practice, Pearson Education
- R.E. Fairley, Software Engineering Concepts, McGraw Hill.
- Ian Sommerville, S/W Engineering, Pearson Education

Scheme of Examination
- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates
- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

L T P C

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CS-713: DIGITAL IMAGE PROCESSING

Maximum Marks: 50 **Maximum Time: 3 Hrs.**
Minimum Pass Marks: 40% **Lectures to be delivered: 50-60**

Course Objective: This course is designed to introduce students with the fundamental concepts and techniques in basic digital image processing and their applications to solve real life problems. The topics covered include Digital Image Fundamentals, Image Transforms, Image Enhancement, Restoration and Compression, Morphological Image Processing, Nonlinear Image Processing, and Image Analysis. Application examples are also included. Upon completion of this course students will be:

- Familiar with basic image processing techniques for solving real problems.
- Have sufficient expertise in both the theory of two-dimensional signal processing and its wide range of applications, for example, image restoration, image compression, and image analysis.
- Analyze general terminology of digital image processing.
- To examine various types of images, intensity transformations and spatial filtering.
- To develop Fourier transform for image processing in frequency domain.
- To evaluate the methodologies for image segmentation, restoration etc.
- To implement image process and analysis algorithms.
- To apply image processing algorithms in practical applications

Course Content

SECTION A

Digital Image Processing: Definition, Examples of Fields that use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.
Digital Image Fundamentals: Image Sensing, and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels, Distance Measures, Linear and Non-linear Operations.
Intensity Transformations and Spatial Filtering: Basic Gray Level Transformations, Histogram Processing, Enhancements using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing, Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

Filtering in the Frequency Domain: Fourier Series, Fourier transform of Functions of One Continuous Variable, Discrete Fourier Transform (DFT) of one variable and Its Inverse, 2-D Discrete Fourier Transform and Its inverse, Properties of 2-D DFT, Image Smoothing using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Laplacian in Frequency Domain, Homomorphic Filtering, Bandreject and Bandpass Filters, Notch Filters, The Fast Fourier Transform in 1-D
Image Restoration : Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations.

SECTION B

Colour Image Processing: Colour Models, Pseudocolour Image Processing, Basics of Full Colour Image Processing. Colour Transformations, Smoothing and Sharpening. Colour Segmentation.
Wavelets and Multi Resolution Processing: The Haar Transform, series expansion, scaling functions, wavelet functions, wavelet transform in 1-D, Inverse Discrete wavelet Transform in 1-D, Fast wavelet Transform in 1-D, Discrete wavelet Transform in 2-D, wavelet Packets

Image Segmentation: Point Detection, Line Detection and Edge Detection, Edge Linking and Boundary Detection, Basic Global Thresholding, Otsu's Method, Multiple Thresholds, Variable Thresholding, Multivariable Thresholding,

Region Growing, Region Splitting and Merging, Use of Motion in Segmentation, Spatial Techniques, Frequency Domain Techniques.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- R. C. Gonzalez, R. E. Woods, "Digital Image Processing", PHI
- K. Jain, "Fundamentals of Digital Image Processing", PHI

Scheme of Examination
- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates
- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.

L T P C

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CS-714 E1: PATTERN RECOGNITION

Maximum marks: 50 **Maximum Time:3 Hrs.**
Minimum pass marks: 40% **Lectures to be taken:50-60**

Course Objective: This course is designed to introduce students with the methodologies, technologies, and algorithms of statistical pattern recognition from a variety of perspectives. Topics including Bayesian Decision Theory, Estimation Theory, Linear Discrimination Functions, Nonparametric Techniques, Support Vector Machines, Neural Networks, Decision Trees, and Clustering Algorithms etc. will be presented. Upon completion of this course students will be:

- Understand basic concepts in pattern recognition
- Gain knowledge about state-of-the-art algorithms used in pattern recognition research
- Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
- Apply pattern recognition techniques in practical problems.

Course Content

SECTIONA

Introduction to Pattern Recognition: What is Pattern Recognition, Pattern Recognition Approaches, Examples of Pattern Recognition Applications. Features, Feature Vectors and Classifiers.

Statistical pattern Recognition: Supervised Learning (training) using parametric and non parametric approaches, linear discriminant functions and discrete and binary feature cases, unsupervised learning and clustering.

SECTION B

Syntactic Pattern Recognition: Syntactic Pattern Recognition via parsing and other grammars, graphical approaches to syntactic Pattern Recognition, learning via grammatical inference.

Neural pattern Recognition: Introduction to Neural Networks, Introduction to Neural pattern associators and matrix approaches, Feedforward Networks and training by back propagation, Content Addressable Memory approaches and unsupervised learning in Neural Pattern Recognition.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Robert J. Schalkoff, "Pattern Recognition: Statistical, Syntactic and Neural Approaches", John Wiley and Sons, NY.
- "Pattern Recognition", Academic Press.

Scheme of Examination

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.

L T P C
5 0 0 5

CS-714 E2: OBJECT ORIENTED ANALYSIS AND DESIGN USING UML

Maximum Marks: 50 **Maximum Time: 3 Hrs.**
Minimum Pass Marks: 40% **Lectures to be delivered: 50-60**

Course Objective: This Object-Oriented Analysis and Design Using UML teach how to effectively use object-oriented technologies and software modelling as applied to a software development process. This course starts with object oriented concepts and moves towards the preparation of standard UML diagrams using an UML modeling tool. After completing this class, student will be able to:

- Describe the three pillars of object-orientation and explain the benefits of each.
- Create use case documents that capture requirements for a software system.
- Create class diagrams that model both the domain model and design model of a software system.
- Create interaction diagrams that model the dynamic aspects of a software system.
- Explain the facets of the Unified Process approach to designing and building a software system.
- Describe how design patterns facilitate development and list several of the most popular patterns.

Course Content

SECTION A

Introduction to Object: Object Orientation, Development, Modeling, Object Modeling technique.
Object modeling: Objects and classes, Links and Association, Generalization and inheritance, Grouping constructs, Aggregation, Abstract Classes, Generalization as extension and restriction, Multiple inheritance, Meta data, Candidate keys, Constraints.
Dynamic modeling: Events and states, Nesting, Concurrency, Advanced Dynamic Modeling concepts
Functional modeling: Functional Models, Data flow diagrams, Specifying operations, Constraints, Relation of Functional model to Object and Dynamic Models.

Design Methodology, Analysis: Object modeling, Dynamic modeling, Functional modeling, Adding operations, Iterating Analysis.
System design: Subsystems Concurrency, Allocation to processor and tasks, Management of data stores, Handling Global Resources, Handling boundary Conditions, Setting Trade-off priorities.
Object Design: Overview, Combining the three models, Designing Algorithms, Design Optimization, Implementation of Control, Adjustment of Inheritance, Design of Associations, Object Representation, Physical Packaging, Document Design Decision.

Comparison of methodologies: Structured Analysis/Structured Design, Jackson Structured Development.
Implementation: Using Programming Language, Database System, outside Computer.
Programming Style: Object Oriented Style, Reusability, Extensibility, Robustness, Programming-in-the-large.

SECTION B

UML: Basics, Emergence of UML, Types of Diagrams.
Use Case: Actors, Use Case Diagram, Relationships between Use Cases.
Classes: Class Diagram, Classes, Objects, Attributes, Operations, Methods, Interfaces, Constraints, Generalization, Specialization, Association, Aggregation.

Behavioral Diagrams: Activity Diagram, Collaboration Diagram, Sequence Diagram, Statechart Diagram.
Implementation Diagrams: Component Diagram, Deployment Diagram

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of

MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- James R. Rumbaugh, Object Oriented Modeling and Design, Pearson Education.
- Bernd Oestereich, Developing Software with UML, Pearson Education.
- Grady Booch, Object Oriented Analysis and Design with Applications, Addison-Wesley.
- Pierre-Alain Muller, "Instant UML", Shroff Publishers
- Booch, Rumbaugh, Jacobson, "The Unified Modeling Language User Guide", Addison Wesley
- Booch, Rumbaugh, Jacobson, "The Unified Modeling Language Reference Manual", Addison Wesley
- Rebecca Wirfs-Brock, "Design Object Oriented Software", PHI

Scheme of Examination

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
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- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed.

L T P C
5 0 0 5

CS-714 E3: NEURAL NETWOKS AND FUZZY LOGIC

Maximum marks: 50 **Maximum Time: 3 Hrs.**
Minimum pass marks: 40% **Lectures to be taken: 50-60**

Course Objective: This course is designed to explore the fundamental theory and concepts of computational intelligence methods, in particular neural net works, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence. Upon completion of this course students will be able to:

- To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
- To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic
- To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Course Content

SECTION A

Introduction of Neural Networks: Concepts of neural networks, Network Properties, Systems Dynamics.
Inference & Learning : Neural Networks, Learning Algorithm, Data representation, Functional Classification, Neuron Concept, terminology, Notation & representation of Neural Networks.
Perception: Single layer perceptrons, MultilayerPerceptrons, perceptron learning & training.

Back propagation: Concept, Back Propagation, Learning Algorithm. A derivation of Back propagation, Kohonen Network, Gross berg networks.
Counter Propagation Networks: Counter propagation Algorithm & its Applications.
Hopfield nets: Concept, Hopfield net Algorithm for Auto-association, Capacity of Hopfield Nets. Hopfield net Algorithm for optimization, stability of Hopfield nets.

SECTION B

Fuzzy Set: Introduction, uncertainty, Newtonian mechanics, Probability Theory, organized simplicity, disorganized complexity, trans computational problems.
Crisp Sets: An overview, fuzzy sets: Basic types, basic concepts. Fuzzy sets versus crisp sets, additional properties of alpha-cuts, representations of fuzzy sets.
Operations on Fuzzy sets: Types of operations, fuzzy complements, Fuzzy instructions: t-Norms. Fuzzy Unicons: t-co norms, combination of operations, aggregation operations.

Fuzzy Logic : Classical logic, logic, reasoning, propositional logic, logic operation's logic formulas, tautology, inference rules, Boolean algebra, properties of Boolean algebra, quantification, predicate logic, multi-valued logic, fuzzy propositions, fuzzy quantifiers, linguistic hedges, Inference from conditional Fuzzy propositions, Inference from conditional and quantified propositions.Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Model, Input space partitioning, Fuzzy modeling.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Li Min Fu," Neural Networks in Computer Intelligence", McGraw-Hill, Inc.
- George J Klir/Bo Yuan, "Fuzzy sets & Fuzzy Logic, Theory & Applications", PHI.
- "Neuro Fuzzy & Soft Computing: A Computational approach to learning & Machine Intelligence", J.S.R. Jang, C.T. Sun, E. Mizutani. Pearson Education.
- Ian Cloete& Jack M. Zurada, "Knowledge based Neuro Computing", University Press.

Scheme of Examination
- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates
- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.

CS-714 E4: NATURAL LANGUAGE PROCESSING

Maximum marks: 50 **Maximum Time:3 Hrs.**

Minimum pass marks: 40% **Lectures to be delivered:50-60**

Course Objective: This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches. After completing this class, student will be able to:

- Learn the leading trends and systems in natural language processing
- Understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts
- Recognize the significance of pragmatics for natural language understanding
- Describe the simple system based on logic and demonstrate the difference between the semantic presentation and interpretation of that presentation
- Describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing

Course Content

SECTION A

Introduction to NLP: Definition, History, Applications, Goals.
Regular expressions and Automata, Morphology and Finite State Transducers.
N-grams: Introduction, Simple (Unsmoothed) N-Grams, Smoothing: Add-one smoothing, Witten-Bell Discounting, Good-Turing Discounting, Back off, Deleted Interpolation. Entropy

HMM: Overview, Viterbi Algorithm

Syntax: Word Classes and Part-of Speech Tagging, Context Free Grammars for English, Parsing with Context-Free Grammars.

SECTION B

Word Sense Disambiguation: Selection Restriction Based Disambiguation, Robust WSD: Machine Learning, Supervised Learning Approaches, Bootstrapping Approaches, Unsupervised Methods, Dictionary Based Approaches.

Machine Translation: Introduction, Language Similarities and Differences, Approaches, Steps involved in machine translation system design.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Jurafsky, D. & J. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing Computational Linguistics, and Speech Recognition" Prentice Hall.
- Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds) "Readings in natural language processing", Los Altos, CA. Morgan Kaufmann.
- Allen, J., "Natural Language Understanding", Redwood City, Benjamin/Cummings.
- Bharti, Akshar,ChaitanyaVineet, Sangal Rajeev, "Natural Language Processing", Prentice Hall.

Scheme of Examination

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter

The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed.

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CS-714 E5: MACHINE LEARNING

Course Objective: This main objective of this course is to provide students with an in-depth introduction to two main areas of Machine Learning: supervised and unsupervised. We will cover some of the main models and algorithms for regression, classification, and clustering. Topics will include simple linear regression and multiple linear regression, Decision tree, kNN, and dimensionality reduction. After completing this class, student will be able to:

- Analyze methods and theories in the field of machine learning and provide an introduction to the basic principles, techniques, and applications of machine learning, classification tasks, decision tree learning.
- Apply decision tree learning, Instance based learning and feature selection in real world problems.
- Understand the use of clustering and clustering techniques.
- Apply inductive and analytical learning with perfect domain theories.
- Critically evaluate and compare different learning models and learning algorithms and be able to evaluate the performance of learning algorithms.

Course Content

SECTION A

Machine Learning: Meaning, definition and applications of machine learning, History of machine learning, Steps involved in a machine learning project, Building a machine learning model: representing training examples, target function, representation of target function, learning algorithms, Basic terminology: features, feature vector, instance space, target function, training data, hypothesis space, inductive bias and Occam's razor principle. Bias versus variance, overfitting and underfitting.

Types of machine learning: supervised learning (classification and regression), unsupervised learning (clustering), reinforcement learning. Classification: binary versus multi-class classification, ZeroR classifier.

Generalization of performace of the learning system, Evaluating the performance of learning algorithms: confusion matrix, sensitivity and specificity, accuracy, precision and recall, k-folds cross validation.

SECTION B

Simple linear regression model, multiple linear regression model, Gradient descent method: incremental gradient descent, batch gradient descent, stochastic gradient descent.

Decision Tree Learning: Decision tree representation, appropriate problems for decision tree learning, building decision trees, principles of information gain and entropy.

Instance based learning and feature selection, k-nearest neighbour algorithm. Curse of dimensionality and the need for feature reduction.

Clustering: meaning and applications of clustering, requirements of a good clustering algorithm, Brief introduction to clustering approaches (partition based, hierarchical, model based, density based, graph theoretic clustering), similarity measures (Euclidean, Manhattan, Minkowski), evaluating the quality of clustering algorithm (Rand index, f-measure). K-means clustering technique.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:
Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- Tom M. Mitchell, Machine Learning, McGraw Hill Education.
- Ethem Alpaydin, Introduction to Machine Learning, PHI.
- Shai Shalev-Shwartz, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press.
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer.

Scheme of Examination

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non-programmable scientific calculator is allowed.

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CS-714 E6: MOBILE COMMUNICATION

Maximum Marks: 50 | **Maximum Time: 3 Hrs.**
Minimum Pass Marks: 40% | **Lectures to be delivered: 50-60**

Course Objective: The main objective of this course is to provide students with a basic understanding in Mobile Communication to become familiar with the various mobile technologies and their application to computer engineering problems. This course provides a vast exposure to engineering professionals for understanding the mobile computing paradigm. On completion of this course students will be able to:

- To understand the concept of cellular communication
- To understand the basics of wireless communication
- Knowledge of GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
- Knowledge of IS-95 CDMA mobile communication standard, its architecture, logical channels, advantages and limitations.
- Knowledge of 3G mobile standards and their comparison with 2G technologies.
- To under multicarrier communication systems.
- To differentiate various Wireless LANs

Course content

SECTION A

Introduction: History of wireless Communication, Reference Model, Applications,
Classification of Mobile Communication Systems: Introduction, Paging Systems, Wireless Telephony, Trunking Systems, Cellular Systems, Personal Satellite Communication Systems, Wireless access to the Local Area Networks.
Wireless Transmission: Frequencies for radio transmission, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular systems.

Medium Access Control: MAC: hidden and exposed terminals, near and far terminals. SDMA, FDMA, TDMA, CDMA, Comparison of SDMA, FDMA, TDMA, CDMA.
Telecommunication Systems: GSM, DECT, TETRA, UMTS and IMT-2000.

SECTION B

Channel Assignment Techniques: Centralized DCA, Decentralized DCA, Fully Decentralized DCA, Hybrid Schemes.
Wireless LAN: IEEE 802.11, 802%, HIPERLAN, Bluetooth, Security in Wireless LAN, Wi Max
Wireless ATM: WATM working group, WATM services, Reference model for WATM, Functions.

Mobile Network Layer: Mobile IP, Dynamic host configuration protocol, Ad hoc networks.
Mobile transport layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/ fast recovery, time out freezing, selective retransmission.

Pedagogy:
The Instructor is expected to use leading pedagogical approaches in the class room situation, research-based methodology, innovative instructional methods, extensive use of technology in the class room, online modules of MOOCS, and comprehensive assessment practices to strengthen teaching efforts and improve student learning outcomes.

The Instructor of class will engage in a combination of academic reading, analyzing case studies, preparing the weekly assigned readings and exercises, encouraging in class discussions, and live project based learning.

Case/Class Discussion Assignments:

Students will work in groups of up to four to prepare a brief write-up due before the start of each class covering the case study or class material to be discussed in the next session. Questions may include a quantitative analysis of the problem facing the decision-maker in the case.

Class Participation:
Attendance will be taken at each class. Class participation is scored for each student for each class.

Text and Readings: Students should focus on material presented in lectures. The text should be used to provide further explanation and examples of concepts and techniques discussed in the course:

- J. Schiller, "Mobile Communications", Addison-Wesley.
- Principles of Mobile Communication by Gordon stuber.

- A.S. Tanenbaum, "Computer Networks", Pearson Education.
- Ivan Stojmenovi&Cacute, "Handbookof Wireless Networks and Mobile Computing", Wiley.
- Hansmann, "Principles Of Mobile Computing", Wiley India.
- Mobile Communication Systems by KrzysztojWesolowski.

Scheme of Examination

- English will be the medium of instruction and examination.
- Written Examinations will be conducted at the end of each Semester as per the Academic Calendar notified in advance
- Each course will carry 100 marks of which 50 marks shall be reserved for internal assessment and the remaining 50 marks for written examination to be held at the end of each semester.
- The duration of written examination for each paper shall be three hours.
- The minimum marks for passing the examination for each semester shall be 40% in aggregate as well as a minimum of 40% marks in the semester-end examination in each paper.
- A minimum of 75% of classroom attendance is required in each subject.

Instructions to the External Paper Setter
The external paper will carry 50 marks and would be of three hours duration. The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates will be required to attempt four questions in all from section A and B selecting not more than two questions from each of these groups. Section C shall be compulsory.

Instructions for candidates

- Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.
- Use of non programmable scientific calculator is allowed.

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CS-715: SOFTWARE LAB – III (Digital Image Processing)

Maximum Marks: 100* **Maximum Time: 3 Hrs.**
Minimum Pass Marks: 40% **Practical Sessions to be Conducted: 55-65**

The Laboratory assignments for this lab will include the assignments mainly from the papers CS-713: Digital Image Processing.

*The splitting of marks is as under
Maximum Marks for Continuous Assessment: 60
Maximum Marks for University Examination: 40

Continuous Assessment (Practical Labs) *Maximum Marks for Continuous Assessment : 60
1. Two tests will be conducted during the semester. Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment. 2. Lab Assignments: 30% of the marks allotted for continuous assessment. 3. Attendance: 10% of the marks allotted for continuous assessment.
University Examination (Practical Labs) *Maximum Marks for University Examination : 40
The evaluation will be done jointly by the team of internal and external examiner. The examiners will give due weightage to Logic development/Program execution, Lab records and viva-voce of the student while awarding marks to the student during end-semester final practical examination.

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CS-716: Research Project

Objectives: Problem identification for research work, Literature survey to identify research gaps for research work, Finalize title of research work and to develop research paper writing skills.

Each student will be required to identify a research problem and perform survey of literature in the area of the research problem identified. The title and objectives for the research work will be finalized by the student in consultation with the Supervisor. Student must have sufficient knowledge about the existing techniques in the research area on which he/she wants to work. Each student is required to submit his/her research synopsis by January 15. However, student can submit his/her synopsis up to January 31, with a fine of Rs. 5,000/-. After January 31, the synopsis will be accepted with a fine of Rs. 10,000/-. However synopsis will not be accepted after April 30. Submission of synopsis after April 30 shall be permitted only after depositing fee for full semester (including tuition fee, other funds and examination fee). In any case, the total period of extension in submission of synopsis cannot exceed 2 semesters after April 30.

The student will be required to give presentation to the Synopsis Evaluation Committee having following members:

i. Head of the Department
ii. Supervisor of the student
iii. Two teachers of the Department nominated by Head of the Department (at least one teacher must be present).

This is a non-credit paper. There will not be any marks for the synopsis. After presentation and viva of the student, the evaluation committee will either accept or reject the synopsis. The decision of the evaluation committee will be displayed on the Department's notice board within 7 working days from the presentation of the synopsis by the student. In case of rejection of the synopsis, the student will submit the revised synopsis along with a fee of Rs. 10,000/- up to April 30. Submission of revised synopsis after April 30 shall be permitted only after depositing fee for full semester (including tuition fee, other funds and examination fee). In any case, the total period of extension in submission of synopsis cannot exceed 2 semesters after April 30.

Furthermore, each student is required to give a certificate, duly signed by the student and counter signed by the supervisor, certifying that the synopsis of the student is free of any kind of plagiarism along with the report of plagiarism detection tool/website as mandated by Punjabi University (if any).

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CS-801: Dissertation

Maximum Marks: 400*
Minimum Pass Marks: 160

*The break-up of marks will be:
- Dissertation Evaluation – 200 Marks
- Seminar and Viva voce – 200 Marks

Objectives: Implement some of the existing techniques and develop some new algorithm/tool and produce meaningful research outputs.

Each student will be required to implement some of the existing techniques and/or develop new techniques related to the research title chosen under Paper: CS-716 (Research Project) and accomplish the objectives set therein. Student will be required to complete a Dissertation and submit the final dissertation any time after April 30 but not later than August 31. Before submission of dissertation, the student must have published/presented at least one paper, related to his/her area of research, in some national/international journal/conference of repute (proof of publication/presentation must be attached with the Dissertation).

In lieu of the thesis work, the student may pursue Software development/Industrial project in industry. However, before proceeding on such a project, the student will have to obtain prior permission from the Head of the Department through Internal supervisor. Joint projects may also be allowed subject to the condition that students shall highlight their individual contributions in the joint project at the time of viva-voce.

Furthermore, each student is required to give a certificate, duly signed by the student and counter signed by the supervisor, certifying that the dissertation of the student is free of any kind of plagiarism along with the report of plagiarism detection tool/website as mandated by Punjabi University (if any).

There will not be any marks for internal assessment of the student. Each student is required to present the seminar and give viva-voce to defend his/her dissertation before the Dissertation Evaluation Committee having following members:

i. Head of the Department/HoD's Nominee
ii. Supervisor of the student
iii. External examiner