Course Structure for Final Year

B. Tech in C.S.E. (A.I. & M.L.)

Semester VII (Term 7)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC9	BTAIC701	Natural Language Processing	3	1	-	20	20	60	100	4
PCC10	BTAIC702	Advanced Computer Vision	3	1	-	20	20	60	100	4
PCC11	BTAIC703	Data Engineering	3	-	-	20	20	60	100	3
PEC-4	**BTAIPE704/ BTAIMPE704**	Professional Elective Course (PEC) -IV	3	1	-	20	20	60	100	4
	BTAIPE704A	1. Time Series Forecasting								
	BTAIMPE704B	2. IOT & Data Analytics								
	BTAIMPE704C	3. Distributed Systems								
	BTAIPE704D	4. Full Stack Development								
OEC-3	**BTAIOE705/ BTAIMOE705**	Open Elective Course (OEC) – III	3	1	-	20	20	60	100	4
	BTAIMOE705A	1.Design Thinking								
	BTAIOE705B	2. Block chain Technology								
	BTAIMOE705C	3. Bioinformatics								
	BTAIOE705D	4. Mobile Application Development								
HSSMEC -6	**BTAIHM706**	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	-	-	2	-	-	-	-	Audit
	BTAIOE706A	1. Foreign Language Studies								
	BTAIOE706B	2. Universal Human Value & Ethics								
	BTAIOE706C	3. Intellectual Property Rights								
LC5	BTAIL707	Natural Language Processing & Data Engineering Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM708	Project Work	-	-	4	60	-	40	100	2
Internship	BTAIP608	Field Training / Internship /Industrial Training –III (Evaluation)	-	-	-	-	-	-	-	Audit
			15	**4**	**10**	**220**	**100**	**380**	**700**	**23**

Semester VIII (Term 8)										
Course Category	Couse Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
Project/ Internship	BTAIF801	Project Work/ Internship	-	-	24	60	-	40	100	12
			-	**-**	**24**	**60**	**-**	**40**	**100**	**12**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Semester –VI

Internship - III

BTAIP608	**Field Training / Internship / Industrial Training**	**Internship**	**Audit**

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the departmentor Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes ofthe Industrial Training Programme.
6. Evaluation of the students' performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

Semester –VII

Natural Language Processing

BTAIC701	**Natural Language Processing**	**PCC9**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
To explore Natural Language Processing (NLP) methods and applications, gaining insights into language understanding, sentiment analysis, and text generation for innovative advancements.

Course Outcomes:
On completion of the course, students will be able to:

CO1	Understand the basics of Natural language processing.
CO2	Analyze the different language models and vector semantics.
CO3	Understand the sequence labelling for text analysis.
CO4	Implement text classification and sentiment analysis systems.
CO5	Implement recurrent network for language models and illustrate the NLP applications.

Course Contents:

Unit No 1: Introduction to NLP **[7 Hours]**

Definition and scope of NLP, Applications and real-world examples of NLP, Linguistic Fundamentals, Regular Expressions, Words, Corpora, Text Normalization: Tokenization and segmentation, Stop word removal, Stemming and lemmatization, Handling capitalization and punctuation, Minimum Edit distance.

Unit No 2: Language Models and Vector Semantics **[8 Hours]**

N-gram models, Language model evaluation, Smoothing techniques, Information Retrieval, Vector space models, Term frequency-inverse document frequency (TF-IDF), Pointwise Mutual Information, Applications of the TF-IDF or PPMI vector models, Word2vec, Relevance ranking algorithms.

Unit No 3: Sequence Labeling **[7 Hours]**

Text Preprocessing, Context-Free Grammars, Part-of-speech tagging, HMM Tagging, CRF, Named entity recognition, Evaluation of Named Entity Recognition. Syntax and Parsing, Parsing techniques: dependency parsing, constituency parsing, Maximum Entropy Markov Models.

Unit No 4: Text Classification and Sentiment Analysis **[7 Hours]**

Classifiers for text classification and sentiment analysis, Optimizing Sentiment Analyzer, Other text classification tasks and the Language Model, Text Classification with Logistic Regression Model, Multinomial logistic regression, Cross-entropy loss function, Gradient Descent, Regularization, Interpreting model.

Unit No 5: Deep Learning for NLP Applications **[7 Hours]**

Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, The Encoder-Decoder Model with RNNs, Words, Characters and Byte-Pairs, Transformers and Pretrained Language Models, Fine-Tuning and Masked Language Models

CASE STUDY: ChatGPT, GPT, AI Powered Tools, Sentiment Classification, Dialog Systems, Chatbots, Movie review system, Text Summarization, Language Translation, Question Answering and Information Retrieval, Automatic Speech Recognition, Text-to-Speech Conversion, Speech to Text Conversion.

Text Books

1. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin.
2. "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and Hinrich Schutze.

Reference Books

1. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper.
2. "Natural Language Processing: Python and NLTK" by Jacob Perkins.
3. “Sentiment Analysis and Opinion Mining” by Bing Liu.

Semester –VII

Advanced Computer Vision

BTAIC702	**Advanced Computer Vision**	**PCC10**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic knowledge of linear algebra and calculus, Image processing fundamentals,

Programming skills in Python.

Course Objectives:
To acquire a comprehensive understanding of Computer Vision principles and techniques, enabling the development of advanced image processing, recognition systems, and visual perception applications

Course Outcomes:
On completion of the course, students will be able to:

CO1	Demonstrate a solid understanding of fundamental computer vision & image processing concepts.
CO2	Apply various computer vision algorithms and techniques in image processing.
CO3	Apply various computer vision algorithms and techniques to solve real-world engineering problems, such as object recognition, motion analysis, and texture.
CO4	Analyze and interpret results obtained from computer vision algorithms, and critically evaluate their performance and limitations
CO5	Implement and evaluate computer vision algorithms using programming languages and libraries commonly used in the field, such as Python and OpenCV

Course Contents:

Unit No 1: Introduction to Computer Vision & Image Processing [7 Hours]
Introduction to computer vision and its applications, Image representation, image processing operations, Image filtering & convolution.
Image enhancement: Contrast stretching, Histogram specification, Adaptive Histogram Equalization (AHE), Wavelet-based enhancement.
Image Filtering: Smoothing: Linear Filter (Box filter, Gaussian Filter) & Non-linear Filter: Median, Mini. & Max.), Sharpening: Laplacian Filter.

Unit No 2: Image Transformation & Restoration: [7 Hours]
Image Transformation: Definition & its properties (scaling, rotation), DFT, DCT, DST, Walsh-Hadamard Transform, Slant Transform, Haar Transform.
Image Restoration: Noise model, Types of Noise: Gaussian, Rayleigh, Erlang, Exponential, Uniform, salt & Pepper noise. Restoration Filtering: Mean Filter (Arithmetic, Geometric, Hormonic, Contrahamonic), Median Filter, Midpoint Filter.

Unit No 3: Segmentation, Texture & Motion Analysis [8 Hours]
Segmentation: Edge Detection (Prewitt, Sobel, Canny), Optimum Edge Detection, Thresholding techniques, Region-based segmentation.
Texture Analysis: Introduction to texture in images, Statistical texture analysis methods: Gray Level Co-occurrence Matrix (GLCM), Local Binary Patterns (LBP); Filter-based texture analysis methods: Gabor filters, Laws' texture energy measures; Texture-based segmentation.
Motion Analysis: Optical flow estimation, Lucas-Kanade method, Horn-Schunck method, Background subtraction, Dense optical flow using Deep Learning (FlowNet), Motion-based segmentation.

Unit No 4: Feature Matching Algorithms **[7 Hours]**

Feature Extraction: SIFT (Scale-Invariant Feature Transform), SURF (Speeded-Up Robust Features), BRISK (Binary Robust Invariant Scalable Keypoints).

Feature Representation: Building a dataset with extracted features, feature vector representation by Bag-of-words, vector quantization.

Feature Classification: SVM, KNN, Random forest.

Unit No 5: Computer Vision with Deep Learning **[7 Hours]**

Image classification: CNN, Attention models, Vision transformation.

Generative Models: GAN.

Object detection: Regions with CNN, Fast R-CNN, Faster R-CNN & Mask R-CNN, SSD, YOLO.

Semantic Segmentation using U-Net, Centroid based object tracking

Text Books / Reference Books

1. Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Cambridge University Press.
2. Computer Vision: Algorithms & Applications, R. Szeleski, Springer. Computer vision: A modern approach: Forsyth and Ponce, Pearson.
3. Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
4. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
5. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
6. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
7. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
8. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
9. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
10. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004.

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Semester –VII

Data Engineering

BTAIC703	Data Engineering	PCC11	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic knowledge of Excel and familiarity with data concepts will be beneficial but not mandatory.

Course Objectives:
To learn data engineering concepts, Advanced Excel, Power BI, Tableau, and basic data analysis for effective data manipulation and visualization.

Course Outcomes:
On completion of the course, students will be able to:

CO1	Understand the importance of data engineering and its workflow in managing and integrating data from various sources.
CO2	Apply advanced data manipulation techniques using Excel functions and tools for efficient data processing.
CO3	Utilize Power BI to connect, transform, and model data from diverse sources into meaningful relationships
CO4	Employ Tableau to prepare and transform data through connections, blending, and calculated fields.
CO5	Integrate and automate data pipelines across tools to streamline data workflows and promote collaboration.

Course Contents:

Unit No 1: Introduction to Data Engineering and Data Analysis Fundamental [7 Hours]

Understanding Data Engineering concepts and importance, Workflow and pipeline, Data sources and data integration.

Basic Concepts of Data Analysis: Data types: Categorical, numerical, ordinal, and time-series data, Data distribution: Measures of central tendency and dispersion, Data visualization: Histograms, box plots, scatter plots, etc., Data preprocessing and cleaning, Exploratory Data Analysis (EDA).

Unit No 2: Advanced Excel for Data Manipulation and Analysis [7 Hours]

Excel Data Manipulation Techniques: Sorting and filtering data, Basic Functions (SUMIF and SUMIFS, COUNTIF and COUNTIFS, AVERAGEIF and AVERAGEIFS, IFERROR, CHOOSE, TEXTJOIN, TRANSPOSE, CONCATENATE, SUBTOTAL, INDIRECT, OFFSET, etc.) Advanced functions (VLOOKUP, INDEX, MATCH, etc.), Text-to-columns and data cleansing, Data validation and conditional formatting.

Excel Data Analysis Tools: PivotTables and PivotCharts, What-If analysis and Scenario Manager, Data tables and Goal Seek, Solver add-in for optimization.

Unit No 3: Power BI for Data Transformation and Visualization [7 Hours]

Introduction to Power BI: Power BI components, Power BI Desktop and Power BI Service, Connecting to data sources.

Data Transformation and Modeling in Power BI: Data loading and shaping using Power Query Editor, Data modeling and relationships, Calculated columns and measures, DAX (Data Analysis Expressions) language fundamentals.

Creating Interactive Reports and Dashboards in Power BI: Visualizations and chart types, formatting and customization options, Drill-through and drill-down capabilities, Filters, slicers, and hierarchies.

Unit No 4: Tableau for Data Preparation and Advanced Visualization [7 Hours]

Introduction to Tableau: Tableau Desktop and Tableau Server, Connecting to various data sources, Understanding Tableau workspace and terminology.

Data Preparation and Transformation in Tableau: Data connections and joins, Data blending and data reshaping. Working with metadata and calculations, Tableau data extracts.

Creating Visualizations and Dashboards in Tableau: Building basic charts and graphs, Interactive filters and parameters, advanced visualization techniques, Dashboard design best practices.

Unit No 5: Data sharing and collaboration and Integration [8 Hours]

Explore more complex data engineering challenges and solutions.

Data Integration: Integrating data from different sources, Automating data pipelines.

Excel Automation and Visual Basic for Applications (VBA): Macro recording and editing, User-defined functions (UDFs), Error handling and debugging.

Power BI Sharing and Collaboration: Publishing and sharing reports, Collaboration features and workspaces, Power BI gateways for on-premises data access.

Sharing and Collaboration in Tableau: Publishing and sharing dashboards, User roles and permissions.

Text Books / Reference Books

1. "Excel Bible" by John Walkenbach (For comprehensive Excel reference)
2. "Power Pivot and Power BI: The Excel User's Guide to DAX, Power Query, Power BI & Power Pivot" by Rob Collie and Avichal Singh (For Power BI and DAX)
3. "Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software" by Daniel G. Murray (For Tableau)

Semester –VII

Time Series Analysis & Forecasting

BTAIPE704A	**Time Series Analysis & Forecasting**	**PEC-4**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic knowledge of statistics and data analysis concepts. Familiarity with data manipulation and visualization using tools like Python or R.

Course Objectives:
To Gain proficiency in analyzing time-dependent data patterns and using statistical methods to make accurate predictions and forecasts for future trends and events.

Course Outcomes:
On completion of the course, students will be able to:

CO1	Knowledge of basic concepts in time series analysis and forecasting
CO2	Understanding the use of time series models for forecasting and the limitations of the methods.
CO3	Ability to criticize and judge time series regression models.
CO4	Distinguish the ARIMA modelling of stationary and nonstationary time series
CO5	Compare with multivariate times series and other methods of applications

Course Contents:

Unit No 1: Introduction of Time Series Analysis [7 Hours]

Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series- Models for time series analysis-Autocorrelation and Partial autocorrelation.
Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting – Resources for forecasting.

Unit No 2: Statistics Background For Forecasting [8 Hours]

Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.

Unit No 3: Time Series Regression Model [7 Hours]

Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order.

Unit No 4: Autoregressive Integrated Moving Average (ARIMA) Models [7 Hours]

Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationarity - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the “BEST” Model - Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models

- Comparing Impulse Response Functions for Competing Models.

Unit No 5: Multivariate Time Series Models and Forecasting [7 Hours]

Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting.

Text Books

1. Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015). https://b-ok.cc/book/2542456/2fa941
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017) https://b-ok.cc/book/3413340/2eb247
3. Time Series Analysis And Forecasting By ExampleSørenBisgaardMurat Kulahci Technical University Of Denmark Copyright © 2011 By John Wiley & Sons, Inc. All Rights Reserved. https://b-ok.cc/book/1183901/9be7ed

Reference Books

4. Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016). https://b-ok.cc/book/2802612/149485
5. Multivariate Time Series Analysis and ApplicationsWilliam W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd. https://b-ok.cc/book/3704316/872fbf
6. Time Series Analysis by James D Hamilton Copyright © 1994 by prince town university press. https://b-ok.cc/book/3685042/275c71

Semester –VII

IOT & Data Analytics

BTAIMPE704B	**IOT & Data Analytics**	**PEC-4**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks

Tutorial: 1 hr./week	Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic knowledge of Programming concepts. Familiarity with Microprocessors and visualization using tools like Python.

Course Objectives: To Gain proficiency in architecture, operation, and business benefits of an IoT solution and using statistical methods to make accurate predictions.

Course Outcomes: On completion of the course, students will be able to:

CO1	Demonstrate the working of IoT
CO2	Identify the need of cloud computing for IoT
CO3	Apply Machine Learning Algorithms for IoT data
CO4	Predict and visualize output using Data Analytic tools
CO5	Identify the Vulnerability in connected networks

Course Contents:

Unit No 1: introduction to IOT [7 Hours]

Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT data vs big data- IoT Analytics lifecycle and Techniques-IoT complete Technology chain- Applications of IoT Opportunities and challenges in IoT.

Unit No 2: IoT and CLOUD [8 Hours]

Cloud computing – Cloud service models – Cloud Deployment models – Need of cloud computing for IoT-Fog computing Vs Cloud Computing for IoT-IoT Cloud Platforms –Microsoft Azure IoT-Amazon Web Services IoT-IBM WATSON IoT-Google's cloud IoT.

Unit No 3: : IOT & Machine Learning [7 Hours]

Principles and foundation of Artificial intelligence and IoT – Machine Learning Paradigms for IoT – Supervised learning for IoT-Linear regression-Logistic regression-SVM – Decision Tree -Naïve's bayesDeep Learning for IoT-Neural Network.

Unit No 4: Data Analytics for IOT [7 Hours]

Defining IoT Analytics - IoT Analytics challenges – IoT analytics for the cloud-Microsoft Azure overview– Designing data processing for analytics – Designing visual analysis for IoT data-Data science for IoT-Feature engineering with IoT data.

Unit No 5: IoT Security [7 Hours]

Overview of IoT Security- security Threats in IoT- APIs in IoT-Authentication in IoT-Strategies for securing IoT-Public Key Cryptography.

Text Books / Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi," Internet of Things: Principles and Paradigms", Elsevier,2016. "AIOps:

2. R. Chandrasekaran," Essentials of Cloud computing", 2nd Edition, Chapman and Hall/CRC, 2015.
3. Amita Kapoor, "Hands on Artificial intelligence for IoT", 1 st Edition, Packt Publishing, 2019.
4. David Etter," IoT Security: Practical Guide Book", CreateSpace Independent Publishing Platform, 2016

Reference Books

1. John Soldatos, "Building Blocks for IoT Analytics", River Publishers,2016.
2. John E. Rossman, "The Amazon way on IoT", Volume 2, John E. Rossman publication, 2016.

Semester –VII

Distributed Systems

BTAIMPE704C	**Distributed Systems**	**PEC-4**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites:

1. Data Structure
2. Operating System

Course Objectives:

Understand the basic concepts and challenges of distributed systems.
Familiarize students with the architecture and design principles of distributed systems.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Gain a comprehensive understanding of distributed computing concepts, models, and communication mechanisms.
CO2	Understand remote procedure calls and handling exceptions and security concerns in distributed systems.
CO3	Comment on Distributed Shared Memory systems and various consistency models
CO4	Identify resource management strategies in distributed environment
CO5	Evaluate the features of good Distributed File System

Course Contents:

Unit 1: Introduction [7 Hours]

Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), Desirable Features of a Good Message-Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multi datagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

Unit 2: Remote Procedure Calls [7 Hours]

Introduction, the RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case studies: Sun RPC, DCE, RPC.

Unit 3: Distributed Shared Memory [6 Hours]

Introduction, general Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

Unit 4: Resource Management [6 Hrs]

Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

Unit 5: Distributed File System [6 Hrs]

Introduction, Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

Text Books

1. P. K. Sinha, Distributed Operating System, PHI Publication.
2. Colorouis, Distributed Systems, Addison Wesley Publication.
3. M. L. Liu, Distributed Computing: Principles and Applications, Addison-Wesley, 2004.

NPTEL Course:

1. Distributed Systems, Prof. Rajiv Mishra, IIT Patna.

Semester –VII

Full Stack Development

BTAIPE704D	**Full Stack Development**	**PEC-4**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic Knowledge of HTML and CSS

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Fundamentals of web essentials and markup languages
2. Use of the Client-side technologies in web development
3. Use of the Server-side technologies in web development
4. Understand the web services and frameworks

Course Outcomes:

On completion of the course, students will be able to:

CO1	Implement and analyze behavior of web pages using HTML and CSS
CO2	Apply the client-side technologies for web development
CO3	Analyze the concepts of Servlet and JSP
CO4	Analyze the Web services and frameworks
CO5	Apply the server side technologies for web development

Course Contents:

Unit No 1: Full Stack Fundamentals [7 Hours]

HTML, Basic, HTML5 Doctype, Some New HTML5 Elements, HTML5 advance feature Canvas Elements, Geolocation API, Responsive Images, Audio and Video Support, Header And Footer, Allow spell check and editable areas, Adding audio, Drag & drop.

CSS Advanced: Advanced Colors: Alpha transparency, At-Rules: Importing style sheets, styles for different media types, specifying the character set of a stylesheet and embedded fonts, CSS3: also known as Cascading Style Sheets Level 3.

Unit No 2: jQuery [8 Hours]

jQuery Introduction, - Overview, Syntax, Selectors, Events, Attributes, jQuery DOM manipulation: - Add Elements, Remove Elements, Replace Elements. jQuery CSS manipulations: CSS Classes, Dimensions, CSS Properties.

Jquery Traversing, Traversing Ancestors, Traversing Descenants.

Unit No 3: Angular JS [7 Hours]

Overview, Environment Setup, AngularJS – MVC Architecture, directives, Expressions, controllers, Angular Lifecycle, HTML DOM, Angular Modules, Angular Components, Angular Data Binding, Angular services, Dependency Injection.

Unit No 4: Javascripts Advanced [7 Hours]

Arrow Functions, Template Strings, Rest Operator, Spread Operator, Object Literals, Destructuring objects in javascript, inheritance, Getting parts of a value: split & substr, Programming fundamentals: Try...Catch And Throw, Getting the users date and time, Some more complex math, Regular Expressions, Get the users browser (navigator), Add timing: setInterval & setTimeout, Javascript Classes, Async in JavaScript, Error Handling in JavaScript.

Unit No 5: Node JS [7 Hours]

Introduction to Node JS, What is Node JS, Node.js Process Model, Node JS Modules: Functions, Buffer, Module, Core Modules, Local Modules, Built-in Modules.

File System, Fs.readFile, Writing a File, Opening a file, deleting a file, Other IO Operations

Database operations: Database Connectivity, Connecting String, Configuring, Working with Select Command, Updating Records, Deleting Records, MERN: Overview of MERN, Introduction of MERN.

Text Books / Reference Books

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035
2. Robert W Sebesta, “Programming the World Wide Web , 4th Edition, Pearson education, 2008 3. Marty Hall, Larry, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
4. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
5. Chris Bates, “Web Programming Building Internet Applications , 3rd Edition, Wiley India, 2006.
6. Xue Bai et al, “The web Warrior Guide to Web Programming , Thomson, 2003

Semester –VII

Design Thinking

BTAIMOE705A	Design Thinking	OEC-3	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic Algorithm concepts

Course Objectives:

1. To recognize the latest and future issues and challenges in design thinking
2. To expose the student with state-of-the-art perspectives, ideas, concepts, and solutions related to the design and execution of innovation driven projects using design thinking principles.
3. To develop an advance innovation and growth mindset form of problem identification and reframing, foresight, and insight generation

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand the concepts of design thinking approaches
CO2	Illustrate and use phases of design thinking
CO3	To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions.
CO4	Understand prototyping and validation for design thinking
CO5	To propose a concrete, feasible, viable and relevant innovation project/challenge

Course Contents:

Unit 1: Overview of Design Thinking Process

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Cantered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyse, Solve and Test.

Unit 2: Empathize

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user persons, customer journey mapping, How might we questions.

Unit 3: Analyse or Define

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

Unit 4: Prototyping and Validation

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

Unit 5: Design Innovation

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

Text Books / Reference Books

1. Bala Ramadurai, “Karmic Design Thinking”, First Edition, 2020

Reference Books:

1. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization by Vijay Kuma.

2. Human-Centered Design Toolkit: An Open-Source Toolkit To Inspire New Solutions in the Developing World by IDEO.
3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.
4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

Semester –VII

Blockchain Technology

BTAIOE705B	**Blockchain Technology**	**OEC-3**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Digital Communication.

Course Objectives:

1. To understand the cryptographic techniques used in blockchain systems and to introduce the fundamental concepts and principles of blockchain technology.
2. Understand the fundamentals of Ethereum and DApps and implementation Smart contract.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Explain the fundamental characteristics of blockchain using bitcoin.

CO2	Demonstrate the application of hashing and public key cryptography in protecting the blockchain.
CO3	Explain the elements of trust in a Blockchain: validation, verification, and consensus.
CO4	Develop smart contracts in Ethereum framework.
CO5	Blockchain Usecases

Course Contents:

Unit No 1: Introduction to blockchain [7 Hours]

History of blockchain, peer to peer (P2P) network, public ledger, double spend problem, features of blockchain, types of blockchain: public, private and consortium based blockchain and applications of blockchain.

Unit No 2: Cryptographic primitives [7 Hours]

Public key cryptography, hash functions, message digest, secure hash algorithms (SHAS-256), digital signature, elliptic curve digital signature algorithms (ECDSA), merkle tree.

Unit No 3: Bitcoin definition, transactions [8 Hours]

The transaction life cycle, the structure of a block, genesis block, wallet, bitcoin mining, forking: hard and soft fork. Consensus algorithms: proof of work, proof of stake, practical byzantine fault tolerance, proof of burn and prof of elapsed time.

Unit No 4: Smart contracts, Ethereum basics [7 Hours]

Introduction to Ethereum & Ether, Gas, the world state, transactions, Ethereum virtual machine (EVM), types of accounts, block structure, ether, DApps. Ethereum vs bitcoin.

Unit No 5: Blockchain Use Cases [7 Hours]

Land Registry Records, Cross-border payments over blockchain, Project Ubin, Food Security, Supply chain financing, Voting system and Identity on Blockchain, Supply chain management, Healthcare and electronic medical records, Blockchain and Metaverse.

Text Books / Reference Books

1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, A Beginner's Guide to Building Blockchain Solutions, Apress, 2018.
2. Ritesh Modi, Solidity Programming Essentials-A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, 2018, Packt Publishing Ltd.
3. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly, 2015
4. William Stallings, Cryptography and Network Security, eighth edition, Pearson, 2020.
5. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O Dowd, Venkatraman Ramakrishna, Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer , Import, 2018.
6. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing, 2020, ISBN: 9781839213199, book website: https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199

Semester –VII

Bioinformatics

BTAIMOE705C	**Bioinformatics**	**OEC-3**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Some familiarity with molecular biology along with probability and statistics

Course Objectives:

1. To introduce students to the rapidly evolving field of bioinformatics
2. To cover the most fundamental topics, such as sequence alignment and pattern finding
3. To gain an understanding of the computational challenges (and their solutions) in the analysis of large biological data sets

Course Outcomes:

On completion of the course, students will be able to:

CO1	Illustrate the basic concepts of bioinformatics, biological databases and their growth.
CO2	Understand genomics and proteomics
CO3	Identifying interactions and applications of microarrays
CO4	Understand the use of bioinformatics in drug discovery
CO5	Pattern finding in protein and DNA sequencing

Course Contents:

Unit 1: Introduction to Bioinformatics

The Brain of Biotechnology Evolutionary Biology Origin & History of Bioinformatics Origin of Bioinformatics/Biological Databases Importance of Bioinformatics Use of Bioinformatics Basics of Molecular Biology Definitions of Fields Related to Bioinformatics Applications. Biological Databases: Introduction Categories of Biological Databases The Database Industry Classification of Biological Databases The Creation of Sequence Databases Bioinformatics Programs and Tools Bioinformatics Tools Application of Programmes in Bioinformatics.

Unit 2: Genomics & Proteomics

DNA, Genes and Genomes DNA Sequencing Genome Mapping Implications of Genomics for Medical Science Proteomic Application of Proteomics to Medicine Difference between Proteomics and Genomics Protein Modeling. Sequence Alignment: Introduction Pairwise Sequence Alignment Sequence Alignment (MSA) Substitution Matrices Two Sample Applications.

Unit 3: Phylogenetic Analysis

Introduction Fundamental Elements of Phylogenetic Models Tree Interpretation Importance of Identifying Paralogs and Orthologs Phylogenetic Data Analysis Alignment Building the Data Model Determining the Substitution Model Tree-Building Methods Tree Evaluation. Microarray Technology: A Boon to Biological Sciences Introduction to Microarray Microarray Technique Potential of Microarray Analysis Microarray Products Microarray Identifying Interactions Applications of Microarrays.

Unit 4: Bioinformatics in Drug Discovery

A Brief Overview Introduction Drug Discovery Informatics and Medical Sciences Bioinformatics and Medical Sciences Bioinformatics in Computer-Aided Drug Design Bioinformatics Tools.

Unit 5: Human Genome Project

Human Genome Project: Introduction Human Genome Project Genome Sequenced in the Public (HGP) and Private Project Funding for Human Genome Sequencing DNA Sequencing Bioinformatics Analysis: Finding Functions Insights Learned from the Human DNA Sequence Future Challenges.

Text Books / Reference Books

1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.
2. "Introduction to Bioinformatics Algorithms" by Neil Jones and Pavel Pevzner.

3. "Bioinformatics" by David Mount (2nd edition).

NPTEL Course:

1. Prof. M. Michael Gromiha, BioInformatics: Algorithms and Applications, https://nptel.ac.in/courses/102/106/102106065/

Semester –VII

Mobile Application Development

BTAIOE705D	Mobile Application Development	OEC-3	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Data Structures, Object Oriented, Java Programming.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Overall life cycle of Android programming
2. Essential Components of an Android Application

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand Android architecture, activities and their life cycle
CO2	Apply the knowledge to design user interface using Android UI and Component
CO3	Describe Memory and File operations in Android
CO4	Manage system database, remote database operations using web services and Firebase

CO5	Apply knowledge of map, location services, Graphics, android system and background services

Course Contents:

Unit No 1: Introduction to Android [7 Hours]

Background about mobile technologies, Android – An Open Platform for Mobile development, Native Android Application, Android SDK Features, Android Architecture, Application Frameworks, Android Libraries, Android Runtime, Dalvik Virtual Machine. Creating First Android Application. Creating Configurations. Android Project Structure. Testing the application (AVD, Active device), Android Manifest file. Running and Debugging.

Unit No 2: User Interface, Activities [7 Hours]

Introduction, Android Application Life Cycle, Activity, Layouts, Application Priority and process states, Fundamental Android UI Design, Study of different layouts, Introducing Views, Creating new Views, Draw able Resources. Designing fragments: Fragments lifecycle, Fragment management and integration. Advanced UI: Adapters, Complex UI components, Menus and Dialogs, Tabbed Activities, Navigation Drawer, Animations, Create activity layouts programmatically. Android Material Design: introduction, properties, Material Styling / Animations, Material Patterns.

Unit No 3: Intents, Broadcast Receivers and Files [8 Hours]

Introducing Intents, Intents and Intent filters, What are Pending Intents, Adapters, Internet Resources, Notifications, Introducing Dialogs, Saving Application Data in external and internal memory, Creating and saving preferences, Retrieving shared preferences, Creating a standard preference activity, Saving Activity State, Saving and Loading Files, Including static
files as Resources, File management tools.

Unit No 4: Database and Content Providers [7 Hours]

Introducing Android Databases, Introducing SQLite, Cursors and content values, working with SQLite Database, Creating new content Provider. SQLite Open Helper and creating a database. Opening and closing a database, working with cursors, Inserts, updates, and deletes. Native Content Providers: Content provider types, searching for content, Adding, changing, and removing content, Native Android Content Providers, Accessing Contact Book, Calendar. Custom Content Providers: Custom Content Provider classes, Publishing content providers. Introduction to Firebase, Real time/Cloud, Authentication in firebase.
Connecting to MySQL using JSON (Web services).

Unit No 5: Telephony, Hardware and Network Services [7 Hours]

Telephony, Reading Phone device details, Reading Sims Details, Incoming and outgoing call monitoring, Tracking Service Change, Introducing SMS and MMS, Sending SMS and MMS, Sending SMS messages manually, Use of Bluetooth, Managing Network Connectivity, Managing Wi-Fi. Google Map - Layout file, Google Map – Android Manifest file, Customizing Google Map, Adding Marker, Changing Map Type.

Note: Hands-on practice should be cover under Tutorial slots.

Text Books / Reference Books

1.John Horton, “Android Programming for Beginners”, 2nd Edition Packt Publishing
2. Pradeep Kothari “Android Application Development Black Book” , DreamTech
3. Dawn Griffiths, “Headfirst Android Development”, 1st Edition, O′Reilly
4. Lauren Darcey, “Android Wireless Application Development”, Shane Conder, Pearson
5. Wei Meng Lee “Beginning Android 4 Application Development”, Wrox

Semester –VII

Natural language Processing Lab and Data Engineering Lab

BTAIL707	**Natural language Processing Lab and Data Engineering Lab**	**LC5**	**0L-0T-4P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

Natural language Processing Lab

List of Practical/Tutorial

Experiment No.	**Title of the Experiment**
1	Convert the text into tokens. Find the word frequency.
2	Find the synonym /antonym of a word using WordNet.
3	Demonstrate a bigram / trigram language model. Generate regular expression for a given text
4	Perform Lemmatization and Stemming. Identify parts-of Speech using Penn Treebank tag set.
5	Implement HMM for POS tagging. Build a Chunker
6	Implement Named Entity Recognizer.

7	Implement semantic role labelling to identify named entities.
8	Implement text classifier using logistic regression model.
9	Implement a movie reviews sentiment classifier.
10	Implement RNN for sequence labelling.
11	Implement POS tagging using LSTM.
12	Word sense disambiguation by LSTM/GRU.

Note:

1. Open-Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents.
4. Conduct any 10 practical.

Data Engineering Lab

List of Practical

Excel -

1. To study and demonstrate fundamentals in Microsoft excel.
2. To study and demonstrate Entering and editing text and formulas.

Advanced Excel –

3. To study and demonstrate working with basic excel functions, modifying an excel worksheet.
4. To study and demonstrate data formatting in an excel worksheet.

Power BI –

5. To study and demonstrate introduction to Power BI, basic charts in Power BI, working with maps, Tables and Matrix in Power BI.
6. To study and demonstrate other charts in Power BI, cards and filters, slicers in Power BI, Advanced charts in Power BI.
7. To study and demonstrate objects in Power BI, Power BI service introduction, power query [text, Date functions].
8. To study and demonstrate Number functions, append files, merge files, conditional columns, power query [imp topics, M language introduction].

Tableau –

9. To study and demonstrate Introduction to Tableau, Data in Tableau, Sets, sorting and filtering in Tableau, parameters.

10. To study and demonstrate Groups, folders and hierarchies, marks card, views and highlighting, formatting in Tableau.
11. To study and demonstrate Lines and bands, Tableau worksheets, charts in Tableau part -1, calculated fields.
12. To study and demonstrate charts in Tableau part -2, aggregation and granularity, database functions, box and whisker plot, time series and forecasting.

Note:

1. Open-Source tools and technology use for programs (Advanced Excel, Power BI & Tableau).
2. Lab should be in the scope of hands of experience and practice related programs.
3. Add case study and Live project experience if any related content.
4. Conduct any 10 practical.

Semester –VII
Project

BTAIM708	**PROJECT**	**PROJ**	**0L-0T-4P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Practical: 024hrs./week	Continuous Assessment : 60 Marks End Semester Examination: 40 Marks

Guidelines for Project

The students shall study in group of max. three members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Cyber security, Computer Vision, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may bein their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions

4. Implement solution using latest technology
5. Write 35-40 pages report and submit with hard binding (use of latex is more suitable).
6. Present / demonstrate the solution in front of faculty member

The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –VIII

Project Work / Internship

BTAIF801	**Project Work/ Internship**	**Project/ Internship**	**0L-0T-24P**	**12 Credits**

Teaching Scheme	**Examination Scheme**
Practical: 24 hrs./week	Continuous Assessment : 60 Marks End Semester Exam: 40 Marks Total : 100 Marks

Guidelines for Project

It is recommended to complete industry or industry sponsored project. The students shall study in group of max. three members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Machine learning or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferablylocal problem may being their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions,
4. Implement solution using latest technology,
5. Write 60-70 pages report and submit with hard binding (use of latex is more suitable),

6. Present / demonstrate the solution in front of faculty member.

The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution.