South Eastern University of Sri Lanka

Faculty of Applied Sciences

Course Specifications

of the

General Degree Programme

2020/2021

Applied Statistics

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Introduction to Statistics</td><td>Course Code</td><td colspan="3">ASM 11212</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hrs.)</td><td>30</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>70</td></tr>
</table>

Aim of the Course:

To provide students with the basic concepts in statistics for the use of explanatory data analysis so that they will be able to apply those techniques successfully in the field of Applied Science.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Acquire the basic knowledge of the discipline of Statistics.
- Demonstrate the ability to use appropriate descriptive statistics to organize, summarize, and display data in a meaningful way.
- Identify the most appropriate method for summarizing a data set to highlight important features of data.
- Carry out explanatory data analysis of a given set of data and interpret.
- Motivate students for an intrinsic interest in statistical thinking

Course Content:

Statistics: Introduction to Statistics, Definition and scope, concepts of statistical population and sample, Data Classification: Quantitative and qualitative data, Discrete and continuous data. Scale of Measurement: Nominal, Ordinal, Interval, and Ratio. Data Collection: Primary and Secondary data. Graphical Presentation of Data: Histogram, Frequency polygon, Frequency curve, Ogive. The measure of Central Tendency: Arithmetic mean, Geometric mean, Harmonic mean, Median, and Mode, Quartiles, Deciles, and Percentiles. Measures of Dispersion: Range, Average Absolute Mean Deviation (AAMD), Inter Quartile Range (IQR), Variance, and Standard deviation for ungrouped and grouped data. Measure of Relative Dispersion: Coefficient of variation, Measure of shapes: Skewness and Kurtosis. Visual Representation of Data: Stem and Leaf display, Box and Whisker plots.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Moore, D. S., & Kirkland, S. (2007). The basic Practice of Statistics (Vol. New York: WH Freeman.
2. S.C.Gupta and Kapoor (2010). Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
3. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
4. Mann, P. S. (2007). Introductory Statistics. John Wiley & Sons.

Course Title	Elementary Probability Theory			Course Code	ASM 11221		
				Pre-request	-		
Level	1	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students with the basic concepts of probability for the use of data analysis so that they will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand and use the terminology of probability.
- Demonstrate the ability to prove results using basic probability axioms and principles, and solve applied probability problems.
- Calculate probabilities using the addition rules and multiplication rules.
- Apply the basic theory of probability to a practical problem.
- Motivate students for an intrinsic interest in statistical thinking

Course Content:

Counting techniques: Permutations and combinations, Probability: Introduction, Random experiments, Sample space, and events. Definition of Probability: Classical, statistical, and Axiomatic. Conditional probability, Laws of Addition and Multiplication, Independent events and trials, and Theorem of total probability. Bayes' theorem and its applications.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Jim Pitman., Probability, Springer, ISBN: 3-540-97974-3
2. Miller, Irwin and Miller, Marylees (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000). Probability and Statistics, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Data Analysis Using SPSS</td><td>Course Code</td><td colspan="3">ASM 11231</td></tr>
<tr><td>Pre-request</td><td colspan="3">ASM 11212, ASM 11221</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>5</td></tr>
</table>

Aim of the Course:

To provide students with the basic knowledge of data management in SPSS for data analysis so that they will be able to analyse data using SPSS software and interpret results successfully in the field of Applied sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define a variety of statistical variables and enter basic data into SPSS.
- Use, understand, and write programme in SPSS to solve statistical problems.
- Carry out a statistical analysis.
- Present the results obtain to convince the clients.
- Write reports on the above statistical analyses.

Course Content:

Introduction: Data View Spreadsheet, Variable View Spreadsheet, Generating Variables, Data Entry, Storing and Retrieving Data View, Running Statistical Procedures, Constructing Graphical Displays, The Output View, The Chart Editor, Programming in SPSS. Data Analysis: Frequency distribution for ungroup and group data (One variable, two variables, and more than two variables), Measure of central tendency: Mean, median, mode, deciles, percentiles, Measures of Dispersion: Range, Quartile Deviation, Inter Quartile Range, Absolute Mean Deviation, Variance, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 50%
- End Semester Examination – 50%

References:

1. Landau, S., & Everitt, B. S. (2003). A handbook of statistical analyses using SPSS. Chapman and Hall/CRC.
2. Field, A. (2013). Discovering statistics using IBM SPSS statistics. Sage.

Course Title	Probability Distributions			Course Code	ASM 12212		
				Pre-request	ASM 11221		
Level	1	Semester	II	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with the basic concepts in properties and distributions of discrete and continuous random variables so that they will be able to apply those successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify the difference between discrete and continuous random variables.
- Compute the expected value, variance, and higher-order moments of both types of random variables
- Describe the shapes of those commonly used probability distributions.
- Identify and apply correct probability distributions to practical problems
- Approximate Binomial probabilities using Normal distribution incorporating a continuity correction.

Course Content:

Discrete and continuous random variables, probability mass, and density functions. Expected value and variance, Moments and moments generating functions of random variables, Order statistics, Discrete Probability Distributions: Uniform, Bernoulli, Binomial, Poisson, Geometric distributions and their applications. Continuous Probability Distributions: Uniform, Normal, and exponential distributions, and their applications, Central Limit Theorem, Approximation: Binomial using Poisson, Binomial using Normal, and Poisson using normal. Introduction to Student's t, F, and Chi-square Distribution.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. John J, Schiller S& Srinivasan R.A., Schaum's Outline of Probability and Statistics, 4th Edition, ISBN 978-0-07-179557-9
2. Lipschutz.S, (2000), Probability., McGraw-Hill, ISBN 0-07-135203-1.
3. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

Course Title	Bivariate Probability Theory			Course Code	ASM 12221		
				Pre-request	-		
Level	1	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students with the basic concepts of bivariate probability for the use of explanatory data analysis so that they will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Calculate probabilities for joint distributions (bivariate).
- Estimate marginal and conditional probabilities.
- Determine whether random variables are independent.
- Calculate covariance and correlation between joint variables.
- Motivate students for an intrinsic interest in statistical thinking

Course Content:

Introduction to jointly distributed discrete and continuous random variables, Bivariate discrete random variables and their properties, Bivariate continuous random variables and their properties, Covariance and correlations for bivariate random variables.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Jim Pitman., Probability, Springer, ISBN: 3-540-97974-3
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000). Probability and Statistics, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Data Analysis Using MINITAB</td><td>Course Code</td><td colspan="3">ASM 12231</td></tr>
<tr><td>Pre-request</td><td colspan="3">ASM 11212, ASM 12212</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>5</td></tr>
</table>

Aim of the Course:

To provide students with the basic knowledge of data management in MINITAB for data analysis so that they will be able to analyse data using MINITAB software and interpret results successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out data management using MINITAB.
- Use, understand, and write programme in MINITAB to solve statistical problems.
- Present the results obtain to convince the clients.
- Write appropriate MINITAB codes to solve problems.
- Write reports on the above statistical analyses

Course Content:

Introduction, Data window, Managing data, Copying and pasting data, Generating pattered data, Opening, Saving, and printing files, Working with database and special text files, Manipulating and calculating data, Manipulating cells, Rows, and columns, Changing column data types and formats, Merging and splitting data, Stacking columns or rows, Recording data, Descriptive statistics, Graphical presentation for both qualitative and quantitative data, Finding the probability values for discrete and continuous distributions.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 50%
- End Semester Examination – 50%

References:

1. Ryan, B. F., & Joiner, B. L. (2001). Minitab handbook. Brooks/Cole.

Course Title	Theory of Statistics			Course Code	ASM 21212		
				Pre-request	ASM 11212, ASM 12212		
Level	2	Semester	I	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with the knowledge to carry out inferential statistics point estimation and interval estimation and obtain inferences from those so that they will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify and describe the desirable properties of the point estimator
- Compute confidence intervals for different parameters and interpret
- Test hypothesis for different parameters and interpret
- Use hypothesis tests for different parameters and sample sizes
- Conduct hypothesis tests for a variety of applications

Course Content:

Introduction: Parameter, Statistic, Estimator, Mean Squared Error (MSE). **Point Estimation**: Properties of point estimators, Unbiasedness, Minimum Variance Unbiased Estimators (MVUE), Consistency, Efficiency, Relative Efficiency, Rao-Blackwell Theorem, Sufficiency, Factorization Theorem, Maximum Likelihood Estimator (MLE). **Interval Estimation**: Constructing confidence interval (CI) for normal population mean – small and large samples. CI for population proportion, CI for paired samples. Sample Size Estimation**:** Determination of sample size for the mean and proportions. CI for the difference between two population parameters: means, proportions, and ratio between two variances under different assumptions.

Hypothesis Testing: Testing hypothesis for population parameters (mean, proportion, variance) in one and two populations under various assumptions; Tests on independent and paired samples.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Canavos G.C. (1984). Applied Probability and Statistical Methods, Little, Brown & Company.
2. Freund J.E. (2204). Mathematical Statistics, Prentice Hall
3. Hogg R.V. & Craig A.T. (1995). Introduction to Mathematical Statistics, Prentice Hall

Course Title	Categorical Data Analysis			Course Code	ASM 21221		
				Pre-request	-		
Level	2	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students with basic understanding of analysing the association between two categorical variables so that they will be able to apply those models successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Find the association between two categorical variables.
- Interpret the results of 2-way tables.
- Derive inferences from 2-way tables.
- Analyze survey data using 2-way tables.
- Interpret the result in the correct and suitable way.

Course Content:

Introduction to 2x2 contingency tables, Testing independence in a 2x2 table and testing independence of I x J tables using Goodness of fit tests, Interpretation of results using percentages, maximum likelihood theory for 2-D tables, Introduction of multiway tables and interpretation of such results, Introduction the concept of log-linear models for higher order contingency tables, Concept of odd ratios and its interpretations.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Jim Pitman., Probability, Springer, ISBN: 3-540-97974-3
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000). Probability and Statistics, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Data Analysis Using SPSS and MINITAB</td><td>Course Code</td><td colspan="3">ASM 21231</td></tr>
<tr><td>Prerequest</td><td colspan="3">ASM 21212</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>5</td></tr>
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Aim of the Course:

To provide students with the knowledge of applying MINITAB and SPSS software for data analysis so that they will be able to analyse data and interpret results successfully in the field of Applied sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out data management using SPSS and MINITAB.
- Use, understand, and write programmes in SPSS and MINITAB to solve statistical problems.
- Present the results obtain to convince the clients.
- Use appropriate software for correct analysis.
- Write reports on the above statistical analyses

Course Content:

Point estimation, Interval estimation for mean: one sample, two independent samples, paired samples, and proportions. Interval estimation for variance, Hypothesis Testing: One sample, two independent samples, and paired samples, ANOVA, Hypothesis test for proportions, Chi-square test using SPSS and MINITAB, Write reports based on output.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 50%
- End Semester Examination – 50%

References:

1. Field, A. (2013). Discovering statistics using IBM SPSS statistics. Sage.
2. Ryan, B. F., & Joiner, B. L. (2001). Minitab handbook. Brooks/Cole.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Applied Regression Analysis</td><td>Course Code</td><td colspan="3">ASM 22212</td></tr>
<tr><td>Pre-request</td><td colspan="3">ASM 12212</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hrs.)</td><td>30</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>70</td></tr>
</table>

Aim of the Course:

To provide students with the basic concepts and theory of simple linear regression models so that they will be able to apply those models successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Find a relationship between two variables, fit simple regression model, and interpret.
- Calculate and interpret confidence intervals for the parameters of the regression models.
- Develop multiple linear regression models.
- Calculate and interpret confidence intervals for the parameters of the multiple regression models.
- Recognize some potential problems if multiple regression analysis is used incorrectly.

Course Content:

Introduction: Concept of modeling, Simple Linear Regression: Introduction, OLSE parameter estimate, properties of estimators: Parameters, Residuals and Mean Squared Error (MSE), Response value, Predicted value, Interval Estimation and Hypothesis Testing of parameters, ANOVA in simple regression, Model prediction analysis, model diagnostics. Correlation Analysis, Matrix approach to simple regression. Multiple Linear Regression: Introduction, estimation of parameters (OLSE), properties of estimators, interval and hypothesis tests of parameters, ANOVA in multiple regression, prediction and model diagnostics, Matrix approach to Multiple Linear Regression. Polynomial and Logistic regression: Introduction, Estimation of parameters, ANOVA, model diagnostics.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Draper, N. R., & Smith, H. (1998). Applied Regression Analysis. John Wiley & Sons.
2. Golberg, M. A., & Cho, H. A. (2004). Introduction to Regression Analysis. WIT press.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Non-Parametric Data Analysis</td><td>Course Code</td><td colspan="3">ASM 22221</td></tr>
<tr><td>Pre-request</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

To provide students with the basic ideas, applicability, and analysis of data using non-parametric methods so that they will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the difference between parametric and non-parametric test
- Choose an appropriate non-parametric statistical test based on the situation.
- Calculate non-parametric statistic value and compare with critical value.
- Interpret results in appropriate statistical ways.
- Use statistical software for non-parametric data analysis.

Course Content:

Introduction to Non-parametric and Categorical Data Analysis, Sign test, Runs test, Wilcoxon's one sample tests, Sign Rank tests, Wilcoxon and Mann Whitney tests, Correlation tests, Fisher's exact tests, K.S-test, Kruskal-Wallis test, Friedman's test.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Gibbons, J. D., & Chakraborti, S. (2014). Nonparametric statistical inference. CRC press.
2. Conover, W. J. (1999). Practical Nonparametric Statistics, 3rd edition. New York, New York: John Wiley & Sons,
3. Sprent, P., and Smeeton, N. C. (2001). Applied Nonparametric Statistical Methods, 3rd edition. Boca Raton, Florida: Chapman & Hall/CRC, ISBN 978-1-4398-9401-9

Course Title	Statistical Computing using SPSS and MINITAB			Course Code	ASM 22231		
				Pre-request	ASM 22242, ASM 22251		
Level	2	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

To provide students with the knowledge of applying MINITAB and SPSS software for data analysis so that they will be able to analyse data and interpret results successfully in the field of Applied sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out data management using SPSS and MINITAB
- Use, understand, and write programme in SPSS and MINITAB to solve statistical problems.
- Explain the results in suitable ways.
- Present the results obtain to convince the clients
- Write reports on the above statistical analyses

Course Content:

Correlation analysis, Fitting simple linear regression models, Fitting multiple linear regression models, Residual analysis, Fitting logistic models, Non-parametric data analysis using SPSS and MINITAB, Write reports based on output.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 50%
- End Semester Examination – 50%

References:

1. Field, A. (2013). Discovering statistics using IBM SPSS statistics. Sage.
2. Ryan, B. F., & Joiner, B. L. (2001). Minitab handbook. Brooks/Cole.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Experimental Designs</td><td>Course Code</td><td colspan="3">ASM 31212</td></tr>
<tr><td>Pre-request</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hrs.)</td><td>30</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>70</td></tr>
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Aim of the Course:

To provide students with knowledge in designing experiments under specific environments and analyse such data so that students will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recommend a suitable design based on the situation.
- Apply statistical methods in analyzing data from such experimental designs.
- Drive statistical inferences from the results of such experimental designs.
- Identify appropriate experimental design in real situations.
- Present the results of the findings in a scientific manner and make conclusions based on the results.

Course Content:

Basic Statistical Concepts in Experimental Designs, Experiments with single factor (CRD), RCBD, Latin Square Design, Pairwise Comparison Method (LSD method, Duncan's multiple range method, Tukey's method, Bonferroni method, Scheffe's method), Orthogonal comparison.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Douglas G Montogomery (2009). Design and Analysis of Experiments. ISBN-10: 0470398825
2. 2. Thattil R.O (1999). Design and Analysis of Experiments., PGIA, UPDN, SL. (DES 519.57)
3. 3. Cochran WG & Cox GM (1957). Experimental Designs, John Wiley & Sons, ISBN 9971-51-311-0

Course Title	Sampling Techniques			Course Code	ASM 31221		
				Pre-request	ASM 12212		
Level	3	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students with statistical concepts and techniques in sampling units, sampling plans, sample size, execution, and estimation so that students will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recognize the various aspects required in designing a survey.
- Design a suitable sampling technique for a particular survey.
- Compute the sample size for a given survey.
- Analyze survey data using statistical software.
- Interpret the results and derive inferences from surveys.

Course Content:

Principal steps in sample survey and sampling, Basic concepts of sampling: Probability sampling and non-probability sampling, Simple random sampling: Introduction, selecting a simple random sample, Estimation of parameters, Determination of sample size, Stratified random sampling: Introduction, Estimation of parameters, Sample Size Determination: Proportional & optimum allocation, Comparison of simple random sampling and stratified random sampling.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Cocharn, W C (1977). Sampling Techniques, ISBN-10: 047116240X
2. Sukhatme, P V, Sukhatme S V and Ashok C (2018). Sampling Theory of Surveys with Applications, 3rd Edition

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Statistical Computing Using SAS</td><td>Course Code</td><td colspan="3">ASM 31231</td></tr>
<tr><td>Pre-request</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>5</td></tr>
</table>

Aim of the Course:

Understand how to use the EViews and SAS programming language to analyze and interpret data more effectively. Learn how to identify statistical techniques and apply data analysis in real life.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out data management using SAS.
- Develop simple and multiple linear regression using SAS and interpret results.
- Analyze qualitative and quantitative data using SAS and interpret.
- Present the results obtain to convince the clients.
- Write reports on the above statistical analyses.

Course Content:

Introduction to SAS, Reading raw data and creating SAS data sets via data lines, in-file, input and set statements, Creating new variables, Programming techniques: conditional execution, looping, arrays, macro programming, Combining data files: Appending and Merging data files, Formatting for presenting results and as a data analysis tool, Enhancing Output using ODS, Character data calculations, Writing Output, Descriptive statistics, Data visualization, Statistical Modeling and Statistical Graphics in SAS, Statistical data analysis for experimental designs.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 50%
- End Semester Examination – 50%

References:

1. SAS Manual
2. SAS Manual (SAS Base and SAS STAT)

Course Title	Statistical Quality Control			Course Code	ASM 32212		
				Pre-request	ASM 12112		
Level	3	Semester	II	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with basic statistical quality control techniques successfully for producing affordable products that meet customer and consumer expectations in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the concepts of quality, quality improvement, and aspects of quality control.
- Become familiar with statistical quality control methods.
- Monitor and improve the quality of products resulting from industrial processes after statistical analysis.
- Detect whether the process has changed in a way that will affect product quality.
- Use Statistical software to analyse SQC data.

Course Content:

Introduction to Quality Control and Six Sigma Concept, Expletory Data Analysis, Statistical Process control, Control charts for variables, Control charts for attributes, Advanced control charting schemes, Process capability analysis, Operating characteristics curves, Sampling plans (AOQL and LTPD plans), Use of statistical software for the analysis of quality control statistics, Miscellaneous topics.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Douglas C Montgomery (2007). Introduction to Statistical Quality Control (6th Edition), ISBN 0470169923
2. John T Burr. Elementary Statistical Quality Control, ISBN-10: 0824790529

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Time Series Analysis</td><td>Course Code</td><td colspan="3">ASM 32221</td></tr>
<tr><td>Pre-request</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

To provide students with the basic knowledge of time series data analysis so that they will be able to apply those techniques successfully in the field of Applied Sciences.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Use a trend equation to forecast future time periods and to develop seasonally adjusted forecasts.
- Identify the correct method of smoothing techniques for time series forecasting.
- Validate forecasting models.
- Determine and interpret a set of seasonal indexes.
- To familiarize the students with time series analysis using statistical software.

Course Content:

Introduction to Time Series, Objectives of time series analysis, Components of a time series: Trend, Seasonal variations, Cyclic variations, Irregular movements, Traditional method of time series analysis: Estimation of trend, seasonal variation, Smoothing techniques, forecasting.

Mode of Assessment and Weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Brockwell, P. J., & Davis, R. A. (Eds.). (2002). Introduction to time series and forecasting. New York, NY: Springer New York.
2. Stephen A. DeLurgio, (1998), Forecasting Principles and Applications, McGraw Hill
3. Chatfield, 2nd Edition, (1980), Analysis of Time Series, Chapman-Hall

Course Title	Statistical Computing using EViews			Course Code	ASM 32231		
				Pre-request	ASM 32142, ASM 32151		
Level	3	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

Understand how to use the EViews and SAS programming language to analyze and interpret data more effectively. Learn how to identify statistical techniques and apply data analysis in real life.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out data management using **EViews**.
- Develop simple and multiple linear regression using **EViews** and interpret results.
- Analyze qualitative and quantitative data using **EViews** and interpret.
- Present the results obtain to convince the clients.
- Write reports on the above statistical analyses.

Course Content:

Various data management methods in EViews, Fit a regression model and Use Eviews, Fit a time series model and uses of Eviews, Report writing on the above statistical analyses

Mode of Assessment and weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 50%
- End Semester Examination – 50%

References:

1. EViews Illustrated Manual

Biology

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Principles of Biology</td><td>Course Code</td><td colspan="3">BLM 11211</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To develop an understanding of basic concepts and principles in Biology
To enhance an interest and develop an appreciation of the nature and diversity of organisms
To create an awareness of the application of biological knowledge to modern society
To develop an ability to make informed evaluations about contemporary biological issues

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Relate the basic principles of Biology to living organisms.
- Identify and justify the cell as a unit of life.
- Demonstrate the fundamental principles of Mendelian genetics.
- Explain and interpret the molecular basis for heredity.
- Demonstrate proper use of the standard tools of biological scientists and the use of metric measurements.

Course Content:

Organization of living systems, energy transfer, continuity of life, biodiversity, and classification of living things: structure and functions of cells and cellular organelles; cellular processes; general biochemistry; DNA structure and function; heredity; evolution; animal development; classification; and introductions to viruses, prokaryotes, Protista, Fungi and Animalia

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. R. Brooker, E. Widmaier, L. Graham and P. Stiling. Principles of Biology (2nd Edition) (2017), McGraw-Hill Education.
2. Laboratory Manual for Principles of Biology I (3rd edition) (2208) by William C. Burnett, Michael B. Beach, and Mark T. Sugalski, Tavenner Publishing Company, Anderson, Sc

Course Title	Biological Chemistry			Course Code	BLM 11221		
				Prerequest	--		
Level	1	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To develop an understanding on chemical processes in living things and energy flow at the cellular level.
To enhance an interest and develop an appreciation of the critical role of biochemistry in sustaining life.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain/Describe chemistry of biomolecules and structures.
- Describe/Discuss chemical processes essential to life.

Course Content:

The important properties of water, The structure and characterization of biological molecules: Carbohydrates, Proteins, lipids and nucleic acids and enzymology; Structure and functions of plasma membranes, cellular mechanisms of energy transduction; important metabolic pathways their cellular compartmentalization, integration and control.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Voet, Donald, Judith Voet, and Charlotte Pratt. *Fundamentals of Biochemistry*. 4th edition. Wiley, 2012.
2. Bugg, T. (2009). Introduction to enzymes and Coenzyme Chemistry (2nd edition). Blackwell Publishing Ltd.
3. Cox, M. and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, Amazon, UK.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Continuity of Life</td><td>Course Code</td><td colspan="3">BLM 11231</td></tr>
<tr><td>Prerequest</td><td colspan="3">--</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To develop an understanding of basic concepts and principles in Continuity of life.
To enhance an interest and develop an appreciation of reproduction in diversity of organisms
To create an awareness of the application of continuity of life to modern society
To develop an ability to make informed evaluations about continuity

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Relate the basic principles of continuity of living organisms.
- Identify and justify the cell as a unit of life.
- Demonstrate the fundamental principles of reproduction relate to Mendelian genetics.
- Explain different types of reproductions and interpret the molecular basis for heredity.

Course Content:

Reproduction, Asexual reproduction, sexual reproduction, reproduction of plants, asexual reproduction of plants, natural and artificial vegetative propagation, sexual reproduction of plants, pollination, fertilization, dispersal of fruits and seeds, germination of seeds, reproduction of man, male and female reproductive systems, menstrual cycle, fertilization and implantation, development of the foetus, and sexually transmitted diseases.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. W. Michael Klymkowsky and M. Meanie Cooper The cell theory and continuity of life
2. D. J Fairbanks. Genetics Continuity of Life

Course Title	Practical Biology I			Course Code	BLM 11241		
				Prerequest	--		
Level	1	Semester	I	Credits	1	Theory (hr)	-
						Practical (hr)	45
						Independent Learning (hr)	05

Aim of the Course:

Introduction to basic biological practical skills development.
To enthuse, inspire and stimulate interest in experimental science.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Use a light microscope, stain, observe biological specimens, measure cell size.
- Carry out basic chemical tests for main biological substances/enzymes.
- Identify cell division stages under microscope work out sums on Mendelian genetics.

Course Content:

Parts and function of a light microscope, observation of a specimen under the light microscope, staining tissues and measure living cells; Tests for Carbohydrates, lipids, proteins and amino acids; The enzymatic activity of Catalase, cyanogenic, and diastase enzymes; Types of reproduction, mitosis meiosis, Sums on the genetic basis of Mendel's experiments and the deviations from Mendelian Genetics

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 50%
- End Semester Examination – 50%

References:

1. John Girkin, 2020, A Practical Guide to Optical Microscopy, 1st edition.
2. Rashmi A. Joshi, 2002, A Textbook of Practical Biochemistry Paperback – Large Print

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Fundamentals of Ecology</td><td>Course Code</td><td colspan="3">BLM 12211</td></tr>
<tr><td>Prerequest</td><td colspan="3">--</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To instil the importance of ecology to contemporary society
To develop understanding on vital ecological services provided by various ecosystems
To enhance the awareness of the effects of biotic-abiotic interactions and how they shape organism adaptation and distribution,
To develop an ability to understand population growth patterns in contrasting environments

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe how organisms are (or are not) adapted to their abiotic environment.
- Describe the principal processes involved in population growth.
- Explain the key ecological interactions of competition, predation and parasitism.
- Relate population-level ecological processes to community or ecosystem-level Processes.
- Explain how ecological principles relate to selected areas of applied ecology.
- Present and interpret ecological data accurately and clearly.

Course Content:

Introduction to Ecology: Climate, terrestrial biomes, aquatic biomes; Functional Ecology: biotic and abiotic factors; Behavioral Ecology, Elements of behavior, Ethology, Behavioral ecology and evolutionary explanation; Population Biology: Life tables and Demography; Population growth and dynamics: competition; Food webs and chemical cycles; Global climate change.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. M. Molles and A. Sher (2019) Ecology: Concepts and Applications, 8th Edition, McGraw Hill
2. J. L. Chapman, M. J. Reiss (1999) Ecology: Principles and Applications, Cambridge University Press.
3. EP Odum and Gary W Barrett (2005) Fundamentals of ecology, Thomson Brooks/Cole

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Fundamentals of Microbiology</td><td>Course Code</td><td colspan="3">BLM 12221</td></tr>
<tr><td>Prerequest</td><td colspan="3">--</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

Introduce importance and basic concepts/principles in Microbiology
Introduce basic microbial techniques
To enhance an interest and develop an appreciation of the critical role of microorganisms in sustaining life and exploiting them in meeting health, agricultural, energy and waste management needs.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate knowledge in basic microbial and microscopic techniques.
- Demonstrate knowledge in microbial structure, physiology, reproduction and ecology.
- Describe/discuss role of microbes in health, food, environment, industry etc.

Course Content:

Introduction; History; Biology of microorganisms with special emphasis on bacteria: morphology, physiology and genetics; Microbial techniques: aseptic techniques, culturing, isolation, purification, characterization and identification of microorganisms; estimation of growth and populations of microbes; Crucial roles of microbes in the biosphere: chemical recycling and ecological interactions; Beneficial and harmful impacts on humans: mutualistic and pathogenic bacteria; Microbial applications in agriculture, energy, health and waste management.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. L. Brislind (2020) Microbiology, Oregin State University, LibreTexts.
2. Pakpour & Horgan (2020) General Microbiology Lab Manual, California State University, East Bay. Libre Texts.

Course Title	Forms and functions of Animals			Course Code	BLM 12231		
				Prerequest			
Level	1	Semester	II	Credits		Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To introduce the organizational levels of multicellular animals.
To develop the knowledge on fundamental aspects of functions animals as a basis of understanding their basic physiological aspects of nutrition, transport, respiration, transpiration and growth and development.
To provide exposure to current research trends in the field of Plant and animal physiology

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recognize the importance of animal physiology.
- Describe animal physiology by elaborating on the concepts and principles of basic topics.
- Describe how anatomical and physiological adaptations have evolved in different ecological contexts.

Course Content:

Different organism levels of multicellular animals; structure and function of animal organ and organ systems: nutrition, digestion, respiration, circulation, nervous systems, endocrine systems, excretion, immunity and nutrition, and developmental biology.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Elaine N. Marieb and Katja Hoehn (2012). Human Anatomy & Physiology, Books a la Carte Edition (9th Edition) Loose Leaf. 2. Gerard J. Tortora (2013). Principles of Anatomy and Physiology 14e with Atlas of the Skeleton Set.
2. Prosser, C.L. (1985) Comparative Animal Physiology (3rd Edition), Satish Book Enterprice Book sellers & Publishers Moti Katra, Agra

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Practical Biology II</td><td>Course Code</td><td colspan="3">BLM 12241</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>-</td></tr>
<tr><td>Practical (hr)</td><td>45</td></tr>
<tr><td>Independent Learning (hr)</td><td>05</td></tr>
</table>

Aim of the Course:

Introduction to basic biological practical skills development.
To enthuse, inspire and stimulate interest in experimental science.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify ecological instruments and use them in collecting basic ecological data.
- Identify microbiological equipments/materials, state their uses, operation and microbiological principles underlying them; Demonstrate basic microbial techniques i.e. aseptic handling, culture media preparation, pure culture isolation, bacterial staining and plate count method and reporting.
- Identify different human organs and explain/relate it to their function.

Course Content:

Identification of selected ecological instruments and their use in qualitative and quantitative studies of abiotic and biotic factors, field visits in different eco systems; Acquaintance with microbiological instruments, preparing culture media, isolating a pure culture, staining bacteria, estimating bacterial population and Microbes in different environments and their roles including a field visit to a water treatment plant. Practical work on structure & functioning of selected organ system of vertebrates with special reference to organ system of human. Locomotion of organisms, Introduction to the study of Human Biology support and movement, Muscular system, Integration and control, Regulation and maintenance, Digestive system and Pregnancy Strip Test.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 50%
- End Semester Examination – 50%

References:

1. Pakpour & Horgan (2020) General Microbiology Lab Manual, California State University, East Bay. Libre Texts.

Course Title	Structure and functions of plants			Course Code	BLM 21211		
				Prerequest			
Level	2	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To introduce the hierarchical organization from cells to the plant body and its growth and differentiation.
To develop knowledge on functions of plants i.e. water relations, nutrition, reproduction and the coordination of growth, development and responses to stimuli.
To inspire on the applications of above in horticulture and other aspects

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate knowledge and comprehension of structural organization of the plant body.
- Demonstrate knowledge and comprehension of functions that maintain a plant, its growth, development and the principles underlying them.
- Relate the functional aspects to relevant structural organization.
- Appraise and apply the significance of structural and functional principles in
- horticultural and other applications

Course Content:

Structure; cells, tissues and organs, primary and secondary growth: Transport in vascular plants; short distance transport, long distance transport in xylem and phloem: Plant nutrition; essential and beneficial elements, nutrient concentration and growth: Photosynthesis and Respiration; Reproduction in flowering plants; flowers, double fertilization and fruits: Plant signals and behaviour; stimuli and responses, phytohormones in plant growth and development

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Campbell N. A. et al., (2015) Biology – A Global approach (10th Edition), Pearson education Ltd., England.
2. Mauseth J.D. (2017) Botany – An Introduction to Plant Biology (6th Edition), Jones and Bartlett Learning, Burlington.
3. Öpik, H., Rolfe, S.A., Willis, A.J. (2005). The Physiology of Flowering Plants. Cambridge University Press.

Course Title	Ecosystem of Sri Lanka: Ecology, Conservation and Management			Course Code	BLM 21221		
				Prerequest			
Level	2	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To impart knowledge on the main ecosystems of Sri Lanka and their ecology and distribution.
To develop awareness on the threats to the main ecosystems
To introduce measures to conserve, manage and restore natural ecosystems

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe/compare environmental features of/among different ecosystems.
- Describe/compare structure and composition of/among ecosystems.
- Discuss importance/significance of different ecosystems
- Discuss threats on the major ecosystems.
- Describe/discuss conservation measures.

Course Content:

Floristic zones of Sri Lanka: geography, topography, geology, climate, soil; Ecosystem types: forests, grasslands, marine, maritime and aquatic, their distribution: extent, abiotic factors, structure, biodiversity, special features, dynamics; Factors responsible for degradation of natural ecosystems; Conservation, management and restoration of natural ecosystems.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Anon. 2000. Natural Resources of Sri Lanka. The National Science Foundation, Sri Lanka.
2. Whitmore, T.C. 1990. An introduction to tropical rainforests. Oxford University Press, Oxford, UK.

Course Title	Field Ecology			Course Code	BLM 21231		
				Prerequest			
Level	2	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To introduce methods of describing vegetation
To introduce sampling methods to quantify, analyze and interpret ecological parameters
To develop skills in ecological experimentation and communication of scientific results in written and oral format.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Formulate ecological hypotheses
- Describe/compare different methods of sampling.
- Design and implement field experiments
- Collect and interpret data and present ecological findings

Course Content:

Introduction; methods of describing vegetation: species lists, life forms, Humboldt's classification, Raunkiaer's classification; structure of vegetation: profile diagrams, visual estimation of abundance (British system, Braun- Blanquet system and Domin's scale) and quantitative measures of abundance (density, cover, basal area, yield, performance, frequency) advantages and disadvantages; sampling vegetation: single plot and multiple plot method, random, systematic and partial random sampling systems, plotless sampling, transects: line, belt and gradsects; density and volume of phytoplankton and benthic algae, vegetation mapping; Field and laboratory work covering above techniques, data analyzing and reporting/presenting.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References

1. Practical Field Ecology: A Project Guide C. Philip Wheater, James R. Bell, Penny A. Cook Wiley.
2. Vegetation Description and Data Analysis: A Practical Approach, 2nd Edition Martin Kent ISBN: 978-0-471-49093-7 November 2011, Wiley-Blackwell.
3. Experimental Plant Ecology: P. Kapur and S. R. Govil (2004). CBS Publishers, India.

Course Title	Practical Biology III			Course Code	BLM 21241		
				Prerequest	-		
Level	2	Semester	I	Credits		Theory (hr)	
						Practical (hr)	45
						Independent Learning (hr)	05

Aim of the Course:

Introducing basic practical skills of plant structure and physiology; expose to natural settings of selected ecosystems; to collect data using different sampling techniques, analyse and report.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Collect data, analyze and report from laboratory experiments and observations on plant structure and functions, ecological data from natural and hypothetical communities.

Course Content:

Structure of plant cells and tissues and organs, Determination of free space of a plant tissue, Transportation; water potential measurement, transpiration rate, transpiration pull, root pressure and guttation, Munch's model of phloem transportation: Photosynthesis: Demonstration of Crassulacean Acid Metabolism (CAM), photosynthetometer (Audus apparatus) Nutrition; Testing for mineral elements in plant tissues: Hormones; discovery of auxin and effects of different hormones; A field tour covering different ecosystems or laboratory work demonstrating ecosystem features, plants and specific features of different ecosystems, their importance and management. Life forms and morphological characters of plans, Determination of the abundance of selected plant species in a particular area by frequency and density method, Determination of minimal area, Determination of pattern of species A in an artificial community by using X2 test method

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 50%
- End Semester Examination – 50%

References:

1. Experimental Plant Ecology: P. Kapur and S. R. Govil (2004). CBS Publishers, India.
2. Practical manual of plant ecology and plant physiology: (2001) S. Sundara Rajan Anmol Pub. New Delhi

Course Title	Molecular Genetics and Biotechnology			Course Code	BLM 22212		
				Prerequest			
Level	2	Semester	II	Credits	2	Theory (hr)	30
						Practical (hr)	-
						Independent Learning (hr)	70

Aim of the Course:

To introduce basic principles in Molecular Biology.
To develop an understanding of the anatomy and functions of the genome and the methods used to study genomes including molecular techniques and DNA sequencing
To introduce methods of identifying genes.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the basic concepts of Genetics and Molecular Biology
- Discuss the function of the gene and mechanism of protein synthesis
- Explain the methods involved in recombinant DNA technology
- 4. Critically analyze the application of biotechnology in different disciplines

Course Content:

Molecular Genetics: Organization of Prokaryotic and Eukaryotic genome, Structure and functions of nucleic acids, Typical gene structure, Gene expression: Transcription, mRNA processing, Non-coding RNA maturation, RNA export. Genetic code, Protein synthesis: Translation, Protein Folding, Translocation, Protein transport. Regulation of Gene expression, Mutation; Biotechnology: rDNA Technology, Steps of genetic engineering, genetic engineering tools, gene cloning, gene cloning in vectors, transformation and screening of rDNA molecules, PCR technique, Gel Electrophoresis, Molecular marker, DNA sequencing, Transgenic plant animal production, Applications of biotechnology in different field, Human genome project.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Benjamin A Pierce (2007). Genetics, A conceptual approach. W. H. Freeman publishers
2. Robert F. Weaver (2002). Molecular Biology. McGraw-Hill
3. Molecular Cloning: A Laboratory Manual Spiral-bound – Import, 12. Joseph Sambrook, E.F. Fritsch, T. Maniatis. December 1989.
4. MIS. Safeena (2018). Know about DNA Technology (available at FAS Library)
5. MIS. Safeena (2018). Laboratory Manual on Biotechnology (Molecular Biology)

Course Title	Animal Behaviour			Course Code	BLM 22221		
				Prerequest			
Level	2	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To develop skills in evaluating the questions in animal behavior and methodologies in animal behavior research

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Appreciate the contribution of scientists towards advancement in Animal Behaviour
- Apply the knowledge to develop the skills in education psychology
- Explain the feeding, reproductive and parental care, and territorial behavior of animals
- Apply the knowledge to increase the animal welfare especially in animal based industries.
- Critically analyze and interpret data from studies of animal behaviour and relate findings to theoretical principles
- Formulate hypotheses about animal behavior and explain the procedures used to explain such hypotheses

Course Content:

Introduction, measuring behaviour, Mechanisms of behaviour, Sign stimulus, stimulus filtering, Movement, Biological rhythms, Bird migration, Development of behaviour, Introduction- Learning, Use of space, Feeding behaviour, Behavioural interactions, Reproductive behavior, Parental care and Social grouping, Communication and Applied animal behavior

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Alcock, J.,(2005) Animal Behavoiur: An evolutionary Approach, 8th edition,. Sinauer Associates Inc. publishers, Sunderland. Massachusetts
2. Krebs, J.R. & Davies, N.B. (1993) An Introduction to Behavioural Ecology, 3rd edition. Blackwell Scientific Publications.
3. Ridley, M. (1995) Animal behaviour: an introduction to behavioural mechanisms, development and ecology. 2nd ed. Blackwell.

Course Title	Practical Biology IV			Course Code	BLM 22231		
				Prerequest			
Level	2	Semester	II	Credits	1	Theory (hr)	
						Practical (hr)	45
						Independent Learning (hr)	05

Aim of the Course:

To introduce basic skills of practical aspects of Genetics, Molecular Biology & Biotechnology and Animal behaviour.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate basic practical skills in Genetics, Molecular Biology, Biotechnolgy and Animal behaviour.

Course Content:

Nucleotide structure, DNA packing, steps and molecules involve in protein synthesis, Agarose gel electrophoresis, PCR technique, Mendelian Genetics.
Measuring Behaviour : Insect grooming Behaviour; handedness and eyedness in human; Associative learning in fish; Learning in Human; Habitat selection; Movement; Factor affecting distress call in chicks; Mini Project.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 50%
- End Semester Examination – 50%

References:

1. Ovid K. Wong, 1988, Experiments With Animal Behavior (New True Books) Paperback
2. Khalid Z. Masoodi, Sameena Maqbool Lone and Rovidha Saba Rasool, 2021, Advanced Methods in Molecular Biology and Biotechnology, A Practical Lab Manual
3. Bal Ram Singh and Raj Kumar, 2021, Practical Techniques in Molecular Biotechnology, Cambridge University Press

Course Title	Horticulture			Course Code	BLM 31212		
				Prerequest			
Level	3	Semester	I	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To introduce basic principles in Horticulture
To develop the practical skills to grow, manage and design experiments and trials with horticultural plants
To introduce physiological and biochemical characters of nutrients and phytochemicals in horticultural products.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate knowledge and skills in application of horticultural principles to the successful growth and production of horticultural plants and sustainable production of fruit, vegetable, and ornamental crops.
- Recognize ethical practices in horticultural applications and synthesis & integration of information to solve horticultural problems.
- Make presentations (oral/poster) to deliver knowledge and techniques to stake holders

Course Content:

Introduction to Horticulture, Branches of Horticulture, Job opportunities in Horticulture, Cropping systems, Cropping calendar, Essential in Nursery Management, Grafting an Budding, Hydroponics, Growing media, Organic farming, , Composting techniques, Irrigation systems in agriculture, Pruning an training of trees and shrubs, Lands scape Horticulture, Ornamental Horticulture, Harvesting methods of fruits and vegetables, Plant tissue culture.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. H. Edward Reiley and Carroll Shry (2000), Introductory Horticulture, 6th Edn., Delmar Cengage Learning.
2. C R Adams and M P Early (2008) Principles of Horticulture, 5th Edn., Butterworth-Heinemann.
3. Carroll Shry and Edward Reiley, (2010) Laboratory Manual for Shry/Reiley's 8th Edn., Delmar Cengage Learning.

Course Title	Applied Entomology			Course Code	BLM 31221		
				Prerequest			
Level	III	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To develop basic knowledge and skills in Entomology
To develop knowledge and skills in identification of economically important insects
To make awareness the basic methods involved in integrated pest management.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate knowledge of/skills in;
- Morphological features, structure, and function of the exoskeleton, feeding habits, internal anatomy, structural and functional adaptations of insects.
- Insect identification characteristics and features of economically important orders.
- Concepts, basics, and methods of integrated pest management and their advantages and disadvantages.
- Economically important insects, natural enemies, and their impact on integrated pest management.

Course Content:

Introduction to Entomology, External morphology of insects, Structure and function of exoskeleton, Feeding habits and mouth parts of insects, Characteristics of insects in economically important orders, Internal anatomy and physiology, Current approach for entomological problems, Insecticides and their target sites, Development of insecticide resistance. Introduction, and definitions for Integrated Pest Management (IPM), Concepts of IPM and advantages, Economically important insects, Basics of IPM for Vegetable and other crops relevant to the region, Natural enemies, Insect pest management, Natural enemies impact of IPM.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. PJ. Gullan and PS. Cranston (2010) The Insects: An Outline of Entomology, Wiley-Blackwell.
2. AS. Packard, (1898) A textbook of Entomology, including the anatomy, physiology, embryology and metamorphoses of insects for use in agricultural and technical schools and colleges as well as by the working entomologist, Macmillan.

Course Title	Practical Biology V			Course Code	BLM 31231		
				Prerequest			
Level	3	Semester	I	Credits	1	Theory (hr)	
						Practical (hr)	45
						Independent Learning (hr)	05

Aim of the Course:

Acquire a working knowledge of the practical techniques used in horticulture.
Introduce to basic practical skills in identification of insects.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify and horticultural tools and explain the uses of them.
- Demonstrate basic horticultural skills i.e seed viability testing, soil testing, plant propagation, greenhouse types and differences and Identification of plant pests and diseases.

Course Content:

Identify the horticultural hand tools and power tools, Testing seeds viability, observing parts of monocot and dicot seeds and understanding epigeal and hypogeal germination, Soil testing, Sexual and asexual propagation of plants, Controlled environment (Greenhouses), Identification of Plant pests and disease Video demonstration of harvesting methods of fruits and vegetables, Field visit an report writing; Identify the insects by using keys, Identify the insects by using keys, Types of development of an insect, Mouth parts, Identify the different types of pests and their control measures**.**

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 50%
- End Semester Examination – 50%

References:

1. Robert P. Rice, Laura Williams and Rice, 1999, Practical Horticulture (4th Edition) Hardcover
2. M.M. Trigunayat, 2016, A Manual of Practical Entomology (Field and Laboratory guide), 3rd Ed., Scientific Publishers.

Course Title	Aquaculture			Course Code	BLM 32211		
				Prerequest			
Level	3	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

Develop knowledge on major elements of marine and freshwater habitats and their functions and skills in identifying and assessing problems threatening aquatic ecosystems.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain major elements of aquatic habitats.
- Explain aspects of ecological functioning of freshwater and marine systems.
- Explain methods and controversies regarding the exploitation of aquatic resources.
- Explain environmental threats to aquatic systems.
- Identify some of the more common aquatic species.
- Analyze and interpret marine ecological data though preparation of graphs, tables, and statistical tests.
- Read, summarize and critique primary scientific literature.

Course Content:

Introduction to Aquaculture, Aquaculture practices, Basic types of aquaculture practices, Cultivable species, Integrated Aquaculture. Introduction to polyculture of fish, Cage culture, Pen culture. Site selection, Species selection, Pond construction and managements of fish farming, prawn farming, freshwater prawn culture and algal farming. Molluscan Aquaculture, Cultured species, (Oysters, mussels, pearl oyster, clams, scallops, abalones), Pearl implantation, Mussels farming, Culture methods, Depuration, Fishing gears, Classification of fishing gears, Active and passive gears, Operation of gears, Fish preservation.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Bardach, J.E. *et.al.* (1972) Aquaculture: The farming and husbandry of freshwater and marine organisms. John Wiley & Sons, New York.
2. Beveridge, M.C.M. (1987) Cage Aquaculture. Blackwell Science, Oxford.
3. Pillay, T.V.R. (1990) Aquaculture: Principles and Practice. Fishing New Books, Oxford.

Course Title	Applied Parasitology			Course Code	BLM 32221		
				Prerequest			
Level	3	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To introduce the basic concepts of parasitology;
To introduce the knowledge of host-parasite relationships
To develop knowledge on epidemiology, transmission, control and treatment of parasitic diseases.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate a broad understanding of the central facts and the experimental basis of modern parasitology.
- Solve problems of a numerical or logical nature in the context of this understanding

Course Content:

Types of parasites, nature of parasitism, advantages and disadvantages of parasitism. Life cycle of some common parasites of man and animals, epidemiology of some tropical parasites; modes of infection, adaptations; life cycle; Mode of transmission; symptoms and pathogenic conditions; control measures; epidemiology of parasitic diseases with special reference to Sri Lanka; Drug resistance; Zoonoses; emerging infectious diseases; Evolution of parasitism; diagnostic techniques of parasitic diseases.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. W.C. Marquardt, R.S. Demaree and R.B. (2000) Grieve Parasitology and Vector Biology..
2. L.H. Ash and T.C. Orihel (2007) Atlas of Human Parasitology, 5th Edn., American Society for Clinical Pathology

Course Title	Animal Husbandry			Course Code	BLM 32231		
				Prerequest			
Level	3	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To impart knowledge on scientific principles in animal physiology, behavior and bioethics.
To develop skills in breeding, data handling and veterinary analytical techniques.
To provide exposure to applied aspects of animal business, animal industry and animal husbandry with insight into conservation and integrated health management.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recognize basic concepts in animal nutrition, animal physiology, behavior and bioethics.
- Identify the aspects of animal business practice, animal industry and land-based business management.
- Recognize the concepts in animal health and welfare, integrated health management and epidemiology of diseases.

Course Content:

Introduction, exotic and domestic animals, basic concepts in animal nutrition, animal psychology, applied animal health and welfare, applied aspects of animal business practice, animal industry and trade, behavior ecology, breeding, conservation and management. integrated health management; bioethics; epidemiology of disease; data handling; Animal adaptation land-based business management; applied animal husbandry, basic laboratory and veterinary analytical techniques.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. A text book of Animal husbandary (1991) GC. Banerjee, Oxford and IbH.
2. Textbook of Animal Husbandry (2012) MK. Rai, Oxford Book Company.
3. Textbook of Animal Husbandry & Livestock Extension (3rd Revised & Enlarged) (2012) P. Mathialagan, Int. Book Distributing Co.

Course Title	Practical VI			Course Code	BLM 32241		
				Prerequest			
Level	3	Semester	II	Credits	1	Theory (hr)	
						Practical (hr)	45
						Independent Learning (hr)	05

Aim of the Course:

Demonstrate practical skills in fundamental parasitological techniques
Demonstrate understanding of the practical skills in the areas of breeding, data handling and basic laboratory and veterinary analytical techniques.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate different aquaculture practices and techniques
- Study the type of parasites and parasitic diseases
- Demonstrate the different types of farms and activities in the region

Course Content:

Study the different Aquaculture in practice world wide, External and Internal anatomy of generalized bony fish; Meristic and Morphometric character of fish: Identification of commercially important fish, shrimps and other aquatic organisms, Study of fishing methods such as gears and crafts use in Sri Lanka and Construction of gears and craft models, Study the different methods of fish food preservation technology, Fisheries, Aquaculture and Industrial study visit to landing sites and Report should be submitted at the end of the course; Types of parasites, Life cycle of some common parasites of man and animals, diagnostic techniques of parasitic diseases. Field visits to different types of farms. Measuring body condition score, Balanced ration, food stuffs, feeding, housing condition, health condition maintenance and management farming animals.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 50%
- End Semester Examination – 50%

References:

1. Jiangsu sheng ke xue Jishuting, 2000, Aquaculture (new scientific knowledge and practical simple rural Reader)
2. Bashir Ahmad Lone, 2018, Practical Handbook of Parasitology
3. T.K. Ewer, 1982, Practical Animal Husbandry

Chemistry

Course Title	Essentials of Inorganic Chemistry			Course Code	CHM 11212		
				Prerequest	-		
Level	1	Semester	I	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with the basic concepts in Essentials of Inorganic Chemistry and refresh and bridge to the knowledge known previously (in G.C.E. A/L) and that has relevance to what t that has relevance would study subsequently

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Appreciate the scientific discoveries that made possible the present knowledge and evolution of new atomic models.
- Describe the major difference between Rutherford's model and Bohr's model.
- Acquire numerical skills and perform simple calculations based on the theories learned, interpret the lines of the H spectrum.
- Solve problems associated with absorption and emission of light (energy).
- Apply the Pauli exclusion principle, Aufbau principle, and Hund's rule to write the electronic configuration of a given atom and predict the orbital based on their quantum numbers.
- Determine the electron configurations of atoms and use periodic trends to make predictions about atomic properties.
- Draw Lewis structures of atoms, molecules, and ions.
- Understand theories of chemical bonding and determine the molecular geometry of molecules using VSEPR theory and the factors that influence molecular shapes.
- Distinguish between sigma (σ) and pi (π) bonds, bonding patterns of (σ) and (π) bonds, find bond orders and propose resonance structures for simple molecules.
- Justify the hybridization concept using examples, draw geometrical shapes of molecular-based on the hybridization concept.
- Compare the chemical and physical properties of s-block, alkali metals, and hydrogen gas.

Course Content:

Atomic Theory and Atomic Structure:

Atomic models: Dolton's, JJ Thomson's, Rutherford's, Bohr's theory of H-atom. Introduction to Quantum theory: Electro-magnetic spectrum, waves and particle nature of matter, Heisenberg uncertainty principle, De Broglie equation. Quantum numbers and electronic structure of atoms, Types of Orbitals, Aufbau principle, Hund's rule, Pauli exclusion principle, electron configuration.

Chemical Bonding:

Chemical bonds and bonding theories: Types of bonds: ionic bonds, covalent bonds (non-polar, polar, and coordinate bonds), metallic bonds, and dipole-dipole interactions (H-bonds, Vander Waals forces, London dispersive forces). Lewis structures; Theory of bonding: VSEPR, valence bond (VB) (molecular geometry), molecular orbital (MO) theories; MO energy level diagram: homonuclear diatomic

molecules (H_2, N_2, and O2); electron-deficient compounds, non-valence cohesive forces, elector-negativity, resonance, dipole moments. lattice enthalpy calculations using Born Haber cycle and Hess's Law.

Properties of Elements:

Periodic classification of elements, vertical, horizontal, and diagonal relationships in the periodic table, trends in the physical and chemical properties of the s, p, and d block elements. Uses of "f" block elements.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Inorganic Chemistry-D.F. Shriver, P.W. Atkins, C.H. Langford
2. Principles of General Chemistry- B. Averill and P. Eldredge
3. Inorganic Chemistry- C. E. Housecroft and A. G. Sharpe
4. Concise Inorganic Chemistry- J.D. Lee

Course Title	Chemical Kinetics			Course Code	CHM 11221		
				Prerequest	-		
Level	1	Semester	I	Credits		Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students the knowledge of basic principles of physical chemistry relevant to the kinetics of chemical reactions

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand and apply the basic concepts of physical chemistry to solve theoretical problems and study chemical/physical processes.
- Write rate expressions for reactions.
- Calculate rate constants, orders of reactions, and activation energy of reactions.
- Deduce mechanisms of reactions.
- Apply steady-state approximations and identify intermediates.
- Apply kinetic laws to consecutive reactions.
- Describe the action of catalysts.

Course Content:

Chemical Kinetics:

Rates of reactions, Rate equations, Factors influencing the rate, Order of reactions: Zeroth (0th), First (1st) & Second (2nd) order, Determination of order of reactions, pseudo-order, Effect of temperature on reaction rates, Arrhenius Equation, Enzyme kinetics, Effects of catalyst, Reaction mechanism, Molecularity, Steady-state treatment, Lindemann mechanism, Transition state theory

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Short answer questions) – 30%
- End Semester Examination – 70%

References:

1. Atkins and Paula, Atkin's physical chemistry. 8th Ed., Oxford University Press Publishing, 2006 (ISBN 978-0195685220).
2. Physical Chemistry (G.F. Liptrot, J.J. Thompson. G.R. Walker

Course Title	Practical Chemistry I			Course Code	CHM 11231		
				Prerequest	-		
Level	1	Semester	I	Credits		Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

To provide hands-on experience in handling glassware, carrying out experiments, and presentation of results

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out titrations involving acids and bases, buffer, and redox systems.
- Design an experimental procedure to solve a problem.
- Record and present the results in a scientific manner

Course Content:

Practical conducted on qualitative analysis of chemical samples.
Safety equipment and safety rules in a lab, Statistical analysis of experimental data, Determination of acetic acid percentage vinegar, Preparation of a buffer, Determination of Na2CO3/ NaHCO3 composition of soda ash, Analysis of a mixture of oxalic acid and sodium oxalate, and concentration of iron (II) in a ferrous solution, hardness of water by EDTA titration, Iodometric determination of ascorbic acid contents in vitamin c tablets, Determination of the equilibrium constant, KC, determination of the solubility-product constant (K_{sp}) for a slightly soluble salt, Molar solubility, common-ion effect, Chromatography analysis of inks and plant pigments, Analysis of heavy metal ion contents in water sample using AAS.

Mode of Assessment and weightage:

- Continuous Assessment (Practical examination. Individual Report, Logbook) – 50%
- End Semester Examination – 50%

References:

1. Vogel's Textbook of qualitative inorganic analysis
2. Handouts issued in the laboratory

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Chemical Thermodynamics</td><td>Course Code</td><td colspan="3">CHM 12211</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
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Aim of the Course:

Provide students the knowledge of basic principles of physical chemistry relevant to thermodynamics of chemical reactions

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand and apply the basic concepts of physical chemistry to solve theoretical problems and study chemical/physical processes.
- Express law of conservation of energy.
- Understand the laws of thermodynamics and identify the functions they introduce (enthalpy, entropy, Gibbs free energy, etc.).
- Understand and perform calculations with the thermodynamic functions, enthalpy, entropy, and free energy.
- Derive essential mathematical relationships in classical Thermodynamics.
- Decide whether a chemical reaction will occur spontaneously or not.

Course Content:

Thermodynamics (TD):
Extensive and intensive properties, TD functions and the law of TD, TD description of systems. Review of basic TD principles and terminology; Zeroth law; first law; work of free expansion against constant pressure and reversible isothermal expansion, isochoric and isobaric heat capacities, variation of free energy and enthalpy with temperature, adiabatic processes. Second law; entropy changes, free energy functions, Maxwell relations, open systems, Clapeyron equation, Clausius-Clapeyron equation.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions) – 30%
- End Semester Examination – 70%

References:

1. Atkins and Paula, Atkin's physical chemistry. 8th Ed., Oxford University Press Publishing, 2006 (ISBN 978-0195685220).
2. Physical Chemistry (G.F. Liptrot, J.J. Thompson. G.R. Walker)

Course Title	Essentials of Organic Chemistry			Course Code	CHM 12222		
				Prerequest	-		
Level	1	Semester	II	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

Provide students a systematic study of the basic principles to understand organic molecules' structure and reactivity, emphasizing nomenclature, stereochemistry, properties, and reaction mechanisms of the major classes of organic compounds.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Analyze the structure of organic compounds by recognizing main functional groups, naming the compounds using the I.U.P.A.C. system, and predicting their properties using the type of bonding, hybridization state, intermolecular forces, and stereochemistry.
- Explain the conformational stabilities of alkanes, cycloalkanes, and mono- and di-substituted cycloalkanes.
- Draw Sawhorse, Newman, and Fisher projection formulas of molecules.
- Identify chiral centers in a molecule and assign R/S configurations.
- Describe mechanisms of reactions: free radical, nucleophilic substitution, elimination, and electrophilic addition, and apply this knowledge to predict the major product in organic reactions, such as those involving hydrocarbons, alcohols, alkyl halides, and alkenes.
- Analyze the nature of a reagent: as a nucleophile, free radical, or electrophile and use this knowledge to propose the synthesis of organic compounds, such as hydrocarbons, alkyl halides, alcohols, or alkenes.
- Demonstrate proficiency in organic laboratory skills as they pertain to chemical information, safe handling, use, and disposal of organic compounds; Systematic Analysis of Functional Groups and writing of laboratory notebooks and reports in accordance with current scientific journal styles.

Course Content:

Basic concept:
importance of organic compounds, atomic structure, atomic structure, and chemical bonds, valence bond (VB) theory, Molecular orbital theory, Polar Covalent Bonds, Electronegativity, Dipole Moments, Formal Charges, Resonance, Rules for Resonance Forms, Drawing Resonance Forms, Reaction intermediates, Transition states, Reaction rates, and equilibria, Polar effects
Acids and Bases: Brønsted–Lowry Definition, Acid, and Base Strength, Predicting Acid–Base Reactions from pKa Values, Organic Acids, and Organic Bases, The Lewis Definition, Noncovalent Interactions between Molecules
Reactions of Alkyl Halides:
Nucleophilic Substitutions, Eliminations, Carbocation, Carbanion, SN2 Reaction, Characteristics of the SN2 Reaction, SN1 Reaction, Characteristics of the SN1 Reaction, Biological Substitution Reactions,

Elimination Reactions: Zaitsev's Rule, The E2 Reaction, E1 and E1cB Reactions, A Summary of Reactivity: SN_1, SN_2, E1, E1cB, and E2
IUPAC Nomenclature: Alkane, Alkene, and alkyne, alkyne, -OH, -COOH, -NH_2, molecules with more than one functional group
Reaction mechanism: Acid-base reaction, Nucleophile, electrophile, acid-base theory
Conformations of ethane, propane, butane, cycloalkane, and substituted cycloalkanes., strain in alkanes and cycloalkanes. Isomers (constitutional isomers, conformers, stereoisomers), Newman projection, anti/gauche, achiral molecules, chiral molecules, stereogenic centers, enantiomers, diastereoisomers, test for chirality (optical activity), nomenclature of enantiomers, Cahn-Ingold-Prelog convention, optical activity, racemization (racemates), separation of enantiomers (resolution), chromatography, Fisher projection, molecules with two (or more) stereogenic centres, diastereotopic compounds (diastereomers) meso compounds, Fisher projection of compounds with more than one stereogenic center, chirality without stereogenic centres: allenes, biphenyls. enantiotopic groups, enantiotopic faces, chemical reactions, substitution reactions.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions) – 30%
- End Semester Examination – 70%

References:

1. Organic Chemistry (John McMurry)
2. Fundamentals of Organic Chemistry (T.W.G. Solomons)
3. Organic Chemistry (T.W.G. Solomons and C.B. Fryhle).

Course Title	Practical Chemistry II			Course Code	CHM 12231		
				Prerequest	-		
Level	1	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

Provide hands-on experience in handling glassware, carrying out experiments, and presentation of results

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify cations, anions, and functional groups in organic compounds using appropriate experimental techniques.
- Design an experimental procedure to solve a problem.
- Record and present the results in a scientific manner

Course Content:

Practical conducted on qualitative analysis of chemical samples.

Anion analysis:

Test for carbonates (CO_3^{2-}), sulphites (SO_3^{2-}) and sulphate (SO_4^{2-}), thiosulphate ($S_2O_3^{2-}$), halides (X^-), chromates (CrO_4^{2-}) and dichromates (CrO_4^{2-}), arsenite (AsO_3^{3-}) and Arsenate (AsO_4^{3-}), (ortho) phosphates, nitrates (NO^{3-}), sulphides (S^{2-}) and Analysis of anion mixtures.

Cation analysis:

Preparation of solution for cation analysis, Cations precipitated as their chlorides Ag^+, $Pb^{2+}$and Hg^{2+} Cations precipitated as their sulphides Cu^{2+}, Sn^{2+}, Cd^{2+}, Sb^{3+}, Bi^{3+}, and As^{3+} Cations precipitated as their hydroxides Fe^{3+}, Al^{3+} and Cr^{3+} Cations precipitated as their sulphides Co^{2+}, Mn^{2+}, Zn^{2+} and Ni^{2+} Cations precipitated as their carbonates Ba^{2+}, Ca^{2+} and Sr^{2+} Other cations Na^+, K^+, NH_4^+ and Mg^{2+}.

Organic Functional group analysis

Mode of Assessment and weightage:

- Continuous Assessment (Practical examination, Individual Report, Logbook,) – 50%
- End Semester Examination – 50%

References:

1 Vogel's Textbook of qualitative inorganic analysis
2 Handouts issued in the laboratory

Course Title	Electrochemistry			Course Code	CHM 21211		
				Prerequest	-		
Level	2	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

Demonstrate concepts of electrochemistry, methods use to study the response of an electrochemical cell and its applications.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the basic principles of conductance, conductivity, mobility of ions, etc.
- Classify solutions as strong electrolytes, weak electrolytes, and non-electrolytes.
- Apply the Kohlraush law and calculate molar conductivity values.
  Classify the electrodes and apply Nernst's equation to calculate the electrode potentials.
- Understand the construction and operation of galvanic and electrolytic electrochemical cells.
- Determine standard and non-standard cell potentials.
- Write half-reactions and combine them to make full (cell) reactions.
- Explain the applications of conductivity and potential.

Course Content:

Electrolytes: Definitions and description of terms: Conductance, Conductivity, Molar conductivity, limiting molar conductivity, types of electrolytes, laws governing conductivity of electrolytes; relationship between molar conductivity of an electrolyte and constituent ions; its dependence on concentration, limiting molar conductivity. Ionic mobility, Kohlrausch law and its applications. Applications of conductivity measurements. Electrodes: Reversible electrode, types of electrodes, definition of electrode potential, electrode potential and standard electrode potential, electrode potentials and Nernst equation. Cells: Definition of Galvanic cell, construction of Galvanic cells, e.m.f. of Galvanic cell, factors affecting it and measurement of e.m.f. of a cell; representation of a galvanic cell: drawing of cell diagram, the relevant cell reaction, and e.m.f. assigned to it; relationship of e.m.f. of a reaction to spontaneity; measurement of e.m.f. of a cell;

Thermodynamics of Galvanic cell: relationship between Gibbs free energy and e.m.f.; dependence of e.m.f. of cells on concentration of ions; definition of activity; application of e.m.f. measurements: solubility product of sparingly soluble salts, pH measurement (pH meter/ion-selective electrode)

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions) – 30%
- End Semester Examination – 70%

References:

1. Physical Chemistry, P.W (1990), Oxford University Press, Oxford.

Course Title	Organic Spectroscopy			Course Code	CHM 21221		
				Prerequest	-		
Level	2	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To develop the knowledge and the understanding of Nuclear Magnetic Resonance spectroscopy (NMR), IR, UV and MS in order to elucidate the organic structures.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe the basic principles behind 1H NMR, 13C NMR, UV, IR, and MS spectroscopy
- Explain the significance of chemical shifts (1H,13C) and their use in functional group identification
- Describe the physical basis of spin-spin coupling
- Express how coupling constants can be used to determine stereochemical relationships
- Show how the enhancement of sensitivity takes place due to Fourier transformation
- Draw the spectra of 1H NMR, 13C NMR, UV, IR, and MS spectroscopy
- Analyze and interpret the 1H NMR, 13C NMR, UV, IR, and MS spectra of simple organic compounds

Course Content:

Infrared (IR) Spectroscopy, UV/VIS- Spectroscopy, Introduction to NMR Spectroscopy, The Chemical Shift, Spin-Spin Splitting in 1H NMR Spectra, Coupling Constants, and spectral analysis of Organic Compounds, 13C NMR Spectroscopy and Spectral analysis of Organic Compounds, Introduction to MS and Fragmentation Patterns

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions) – 30%
- End Semester Examination – 70%

References:

1. James Keeler, Understanding NMR spectroscopy, 2nd ed., Chichester, U.K.: John Wiley and Sons, 2010
2. L.D. Field, S. Sternhell, J. R, 4th ed Organic structures from spectra, Chichester: John Wiley and Sons Ltd, 2008
3. Ning, Yong-Chen, Structural identification of organic compounds with spectroscopic techniques, Weinheim: Wiley-VCH, 2005

Course Title	Analytical Chemistry			Course Code	CHM 21231		
				Prerequest	-		
Level	2	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

Provide students with a broad understanding of the fundamental of analytical chemistry and its application, mainly focusing on classical but still widely used wet chemical methods.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Work safely and competently in an analytical laboratory setting.
- Statistically analyze given experimental data
- Analyze chemical equilibrium in aqueous solution
- Performed different types of titrations
- Choosing appropriate indicators for different types of titrations
- Preparation of Buffer solution with specific buffer capacity and pH

Course Content:

Basic Statistic for Chemists:
Types of Errors, Mean, Mode, Range, Median, Standard Deviation, Variance, Confidence Interval, Hypothesis test, t-test, z-test, Q-test.
Chemical equilibrium:
Acids and Base definition, Acid dissociation constant Ka, Base dissociation constant Kb, Water dissociation constant Kw, Solubility Product Ksp, Formation constant Kf, Conditional formation constant Kf', Henderson Hasselberg equation, Mono-and multi-dentate ligands, Metal-Chelate complexes, Fraction of species in complexometric reaction α, EDTA and Metal complexes, Common ion effect, Le Chateleir's principle.
Buffer solution:
effective buffer capacity, Buffer capacity, Buffer using polyprotic acids, Composition of buffer solution (α) as a function of pH.
Titration:
Neutralization titration, Primary and secondary standard, Acid/Base indicators, pH range of indicators, Titration error with acid-base indicator, Titration of S. acid with S. base, Constructing hypothetical titration curve, Titration of S. base with S. acid, Titration curve for weak acid and S. base, The Effect of Concentration for w. acid/s. base titration, Titration Curves for Weak Bases, and s. acids, Complex Acid/Base Systems, Polyfunctional Acids and Bases, Titration Curves for Polyfunctional Acid
Indicators:
Choosing an Indicator for w. acid/s. base titration, Effect of the concentration in choosing an indicator

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions) – 30%
- End Semester Examination – 70%

References:

1. Fundamentals of Analytical Chemistry (Skoog, West and Holler, 7th Ed., 1996, Saunders College Publishing)
2. Analytical Chemistry, Gary D. Christian, 6th edition, John Wiley Publishers, 2003

Course Title	Practical Chemistry III			Course Code	CHM 21241		
				Prerequest	-		
Level	2	Semester	I	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

To train students in designing and performing experiments, taking measurements using instruments, interpretation, analysis, and presentation of results. Mainly focus on physical chemistry practical.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recognize accurate and precise measurement techniques.
- Judge the numerical criteria for selecting an analytical method.
- Recognize the uses/applications of AAS & AES, Fluorescence & Molecular luminance Spectroscopy etc.
- Principles and applications of various chromatographic techniques (TLC, GC, HPLC, etc.)
- Design experimental procedures to solve chemistry-related problems.
- Record and present the experimental results in a scientific manner

Course Content:

Determination of HSO_4^-, Determination of Extinction coefficient by Calorimetric methods, Partition coefficient, determining thermodynamic solubility products of $CaSO_4$ at room temperature, determination of the degree of association of CH_3COOH in CCl_4, Chemical kinetics- temperature dependency on the rate of the reaction, Determination of thermodynamics quantity for the reaction, Determination of Distribution coefficient for all salicylic acid between H_2O and $CHCl_3$, Determination of adsorption isotherm of CH_3COOH, Determination of the endpoint using conductometric titration.

Mode of Assessment and weightage:

- Continuous Assessment (Practical examination, Individual Report, Logbook) – 50%
- End Semester Examination – 50%

References:

1. Instrumental methods of Chemical Analysis OUSL, Open University of Sri Lanka (2002)
2. Handouts issued in the laboratory.

Course Title	Coordination Chemistry			Course Code	CHM 22211		
				Prerequest	-		
Level	2	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide thorough knowledge in the structure and properties of coordination compounds

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Be able to name and classify simple inorganic compounds.
- Describe the bonding and properties of transition metal coordination compounds.
- Describe the structures and stereochemistry of transition metal complexes.
- Describe and explain the bonding in d-metal complexes using crystal field and ligand field theories and the 18-electron rule.
- Describe various metal-ligand interactions in terms of sigma- and pi-bonding interactions.
- Explain the stability of d-metal complexes, their reactivity, and the mechanisms of ligand substitution reactions.
- Name coordination complexes using IUPAC nomenclature.
- Predict the properties of coordination complexes based on their structures.
- explain the bonding and properties of transition metal complexes using the relevant theories.

Course Content:

Electron configurations of transition metals; oxidation state formalism
Introduction (Werner theory), Coordination numbers, classification of ligands, the nomenclature of coordination compounds, stabilities and stability constant, reaction mechanisms, isomerism, reduction potentials in the presence of ligands.
Co-ordination bond theories: VB, CFT, and MO. Magneto-chemistry, application of theories in the interpretation of spectra of d1 and d9 complexes.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer question) – 30%
- End Semester Examination – 70%

References:

1. An introduction to transition metal chemistry. Orgel, L. E., (1966), Methuen, London
2. Advanced inorganic chemistry (F.A. Cotton and Wilkinson)
3. Concise inorganic chemistry (J.D. Lee)
4. Inorganic chemistry (J.E. Huheey)
5. Textbook of quantitative inorganic analysis (A.I. Vogel)

Course Title	Organic Synthesis and Reaction Mechanisms			Course Code	CHM 22221		
				Prerequest	-		
Level	2	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide an understanding of organic synthesis, reaction mechanism, and reactivity of the most important functional groups.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recall the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions, and mechanism.
- Identify the functional groups in organic compounds.
- Classify the different types of reagents involved in organic synthesis.
- Propose a reasonable mechanism (SN_1, SN_2, E1and E2) for a chemical reaction.
- Predict the organic product with the stereochemistry of chemical reactions.
- Develop basic skills for the multi-step synthesis of organic compounds.

Course Content:

Reagents in Organic Synthesis:
Oxidizing agents, reducing agents, Protecting groups, Chromium Reagents, Manganese Reagents, Silver, Ruthenium, other metals,
Non-Metal Based Reagents:
Activated DMSO, Peroxides and Peracids, Oxygen/ ozone,
Different classes of reactions:
Aldol reaction, Claisen condensation, Diekman cyclization, Alkylation of enolates, Michael addition and Robinson's annelation, Diels-Alder Reaction, and the Wittig Reaction.
Introduction to reaction mechanisms:
SN_1, SN_2, E1, and E2 mechanisms

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions)– 30%
- End Semester Examination – 70%

References:

1. Jerry March, Advanced Organic Chemistry Reactions, Mechanisms and Structure, 4th Edition, John Wiley & Sons, 1992
2. W.H. Brown "Introduction to Organic Chemistry", 1997
3. Designing Organic Syntheses: A Programmed Introduction to the Synthon Approach. Stuart Warren *Wiley*, 1978
4. The Logic of Chemical Synthesis E.J. Corey *Wiley*, 1989
5. Modern Organic Synthesis: An Introduction, George S. Zweifel, Michael H. Nantz*Freeman*2006.

Course Title	Quantum Chemistry and Surface Chemistry			Course Code	CHM 22231		
				Prerequest	-		
Level	2	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To introduce the concept of quantum mechanics; describe the mathematical model of atoms and calculate the energy levels.
To provide basic knowledge of surface chemistry from a physical-chemical perspective.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Work safely and competently in an analytical laboratory setting.
- Statistically analyze given experimental data
- Analyze chemical equilibrium in aqueous solution
- Performed different types of titrations
- Choosing appropriate indicators for different types of titrations
- Preparation of Buffer solution with specific buffer capacity and pH

Course Content:

Quantum Chemistry:
The failures of classical physics, the dynamics of microscopic systems Introduction. The Schrödinger equation, interpretation of the wave function, operators, Eigen values and Eigen functions, quantum mechanical models, particle in a box system, quantized energy levels and degeneracy, probability functions, normalization, postulates in quantum mechanics, and expectation values.
Surface Chemistry:
Description of various interfaces, surface tension, viscosity, vapor pressure, normal boiling point, capillary action, physisorption, chemisorption, Adsorption Isotherms: Langmuir, Freundlich and Gibbs adsorption isotherm; Some applications of surface chemistry in industry.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions)– 30%
- End Semester Examination – 70%

References:

1. Introduction to Quantum Mechanisms, 3rd Edn P.T. Mathews; Tata McGraw Hill (1974)
2. A textbook of quantum mechanics P.T. Mathews; Tata McGraw Hill (1976)
3. Introduction to colloid and surface chemistry Shaw, J. Duncan; Butterworth, London (1980)

Course Title	Practical Chemistry IV			Course Code	CHM 22241		
				Prerequest	-		
Level	2	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

To provide continued practice on laboratory techniques and development of laboratory skills, interpretation data, and report writing.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Develop the basic practical skills for the synthesis and analysis of organic compounds.
- Show the ability to work independently as well as within a team.
- Assemble fractional and simple distillation apparatus, vacuum filtration and refluxing apparatus
- Operate instruments such as melting point apparatus.
- Write comprehensive reports on experiments such crystallization, synthesis, and filtration processes

Course Content:

hydrolysis of methyl salicylate and synthesis of acetylsalicylic acid (aspirin), preparation of p-nitro acetanilide from aniline, preparation of 4-bromoaniline and preparation of 2.4-dinitroaniline, preparation of tribromo benzene from aniline, preparation of anthranilic acid from phthalimide, preparation of benzil and preparation of benzylic acid, preparation of phenyl urea, preparation of ortho and para nitrophenol, synthesis of dibenzalacetone, nitration of methyl benzoate, synthesis of 1,2,3,4-tetrahydrocarbazole, synthesis of 7-hydroxy-4-methyl coumarin, preparation of e-3-phenylpropenoic acid.

Mode of Assessment and weightage:

- Continuous Assessment (Practical examination, Individual Report, Logbook)– 50%
- End Semester Examination – 50%

References:

1. Williamson, K.L. Macro scale and Microscale Organic Experiments. Houghton Mifflin: Boston, 1999
2. Bell, Clark, Ault, Addison "Techniques and Experiments for Organic Chemistry," 5th Ed.; Waveland Press:
3. Taber & Rodig. Organic Chemistry Laboratory – Standard & Microscale Experiments. Saunders College Publishing:
4. Arun Sethi, Lab experiments in organic chemistry, New Age International Publishers.

Course Title	Solid State Chemistry and Organometallic Chemistry and Practical Chemistry V			Course Code	CHM 31212		
				Prerequest	-		
Level	3	Semester	I	Credits	2	Theory (hrs.)	20
						Practical (hrs.)	30
						Independent Learning (hrs.)	50

Aim of the Course:

To provide students the knowledge on basic concepts and theories of solid-state chemistry and organometallic chemistry that are considered necessary for the completion of bachelor's degree education.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain basics related to crystal structures; unit cell, 7 possible unit cell shapes, 14 Bravais lattices, lattice planes, close-packing, common examples for different close-packing modes, crystal defects
- Calculate unit cell density, and packing efficiency of a given crystal structure
- Relate the bonding nature of solids to properties
- Explain different synthetic routes of solids
- Describe different diffraction methods used in characterizing crystals
- Describe the bonding nature of organic ligands and the bonding, structure, VEC, and properties of their organometallic compounds.
- Describe the common organometallic reactions and be able to draw reasonable reaction mechanisms.
- Recognize the contribution of organometallic compounds (mainly trace metals) to the industry – catalytic applications

Course Content:

Solid State Chemistry:

Crystal structures, Close-packing, Lattices, lattice parameters, Lattice energy calculations, Bravais lattices, unit cell, crystal systems, crystal plane and Miller indices. Crystal Structure Analysis: Diffraction techniques, XRD, Bragg's equation. Crystal defects. Bonding in solids. electronic, optical and magnetic properties of solids.

Organometallic Chemistry:

Electron configurations of transition metals; Oxidation state formalism. Types of common organic ligands found in organometallic complexes and their MO nature, Metal-Ligand bonding, 18-en and 16-en configurations, limitations to 18-en rule, coordinative unsaturation, Metal carbonyls; metal cyanides, metal nitriles, metal olefin complexes, metal complexes with aromatic rings.

Reactivity of organometallic compounds - Oxidative addition, Reductive Elimination, Insertion, Association, dissociation, Substitution, Elimination and oxidative coupling. Identification of reactions in industrial catalytic Applications.

Practical:

Synthesis of coordination compounds and alums. Recrystallization techniques, Redox potentials of coordination compounds.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions , Practical examination)– 30% ((15% Theory + 15% Practical))
- End Semester Examination – 70% (35% Theory + 35% Practical)

References:

1. West, A.R., Solid State Chemistry and its Applications, 2nd Edition, 2014.
2. Lesley E. Smart, Elaine A. Moore, Solid State Chemistry An Introduction. Taylor and Francis, 3rd Ed, 2005 (ISBN 0-203-49635-3).
3. Atkins, Overton, Rourke, Weller, Armstrong and Hagerman, Shriver and Atkin's Inorganic Chemistry. 5th Ed. Oxford University Press, 2010 (ISBN 978–1–42–921820–7).
4. Miessler, Fischer, and Tarr, Inorganic Chemistry. 5th Ed. Pearson, 2014 (ISBN 978-0-321-81105-9).
5. Robert H. Crabfree, The Organometallic Chemistry of the Transition Metals, 5th Ed. Wiely.

Course Title	Chemistry of Biomolecules			Course Code	CHM 31221		
				Prerequest	-		
Level	3	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	
						Independent Learning (hrs.)	35

Aim of the Course:

To provide an understanding of the chemistry of biomolecules (carbohydrates and Proteins) and their reactivity.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Distinguish between monosaccharides, disaccharides, and polysaccharides found in food
- Describe the chemistry of monosaccharides and disaccharides
- Describe the reducing action of sugars
- Identify the structure of amino acids.
- Describe the chemistry of amino acid and protein
- Describe the different levels of protein structure and their interdependence

Course Content:

Introduction: classification of carbohydrates, Structure of Glucose; Fischer Projections and the D–L Notation, The Aldotetroses, Aldopentoses and Aldohexoses, cyclic and open-chain form, Furanose Forms, Pyranose Forms, Mutarotation, Anomers, Reactions of Monosaccharides, The D-Family of Aldoses: Synthesis and degradation of Monosaccharides, Deoxy Sugars, Epimers, Determination of Ring Size, Classification of Disaccharides, glycosidic linkages, Reactions of Disaccharides, Carbohydrate Structure Determination, Polysaccharides: Cellulose, Starch and Glycogen, Glycogen,

Amino acids and Protein: Introduction to Protein, Functions of Proteins, Classification of Amino Acids, Structure of amino acids and Proteins, Isoelectric Point of amino acids, Acid–Base behaviour of Amino Acids, Amino acid analysis, Amino acid analysis of peptides, Sequencing amino acids,

Analysis of amino acids: Terminal residue analysis, Sanger's Reagent, Edman degradation, Partial Hydrolysis of Peptides, Enzyme hydrolysis of Peptide bond.

Separation of AA: electrophoresis and Ion exchange chromatography, The Strategy of Peptide Synthesis, Amino Group Protection, Carboxyl Group Protection, Peptide Bond Formation, Solid-Phase Peptide Synthesis: The Merrifield Method levels of protein structure and their interdependence

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions , Take-home assignments)– 30%
- End Semester Examination – 70%

References:

1. Biochemistry (C. K. Mathews & K. F. van Holde)
2. Biochemistry (D. Voet & J. G. Voet)

Course Title	Industrial Chemistry			Course Code	CHM 31231		
				Prerequest	-		
Level	3	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	
						Independent Learning (hrs.)	35

Aim of the Course:

To provide a basic knowledge about the insight of and industrial process and to understand the role of chemistry, chemical principles and concepts used in the context of industrial processes, where chemicals are used as raw materials and/or produced as the end product.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the necessity of the (chemical) industries, the concept of designing and running a chemical plant.
- Estimate the necessary factors needed to establish an industry.
- Write the important stages in the production of a new product.
- Define, describe, and apply basic chemical processes involved in the production of major commercial products used in society.
- Compare continuous and batch processes.
- Write down the important steps in the production of sulphuric acid, nitric acid and ammonia.
- Identify the key processes in the Chlor-alkali industry.
- Illustrate the processes in the production of chlorine and sodium hydroxide.
- Draw the flow diagram for the ammonia-soda (Solvay) process.
- Write a concise report on the industries based in Sri Lanka.
- Recognize the importance of industrial preparation of naturally existing gases.
- Describe the conditions needed and steps involved in producing those gases in liquid form by the fractional distillation method.
- Draw the flow diagram for the ammonia-soda (Solvay) process.
- Write a concise report on the industries based in Sri Lanka.
- Recognize the importance of industrial preparation of naturally existing gases.
- Describe the conditions needed and steps involved in producing those gases in liquid form by fractional distillation method.
- Draw the flow diagram for the production of sodium chloride.
- Describe the raw materials used and the process(es) involved in the mineral-based industries operating in SL.
- Discuss the challenges faced by these industries

Course Content:

Establishing an industry:
Industrial revolution. Importance of a chemical industry in the present-day context; Conditions and requirements for setting up of an industry (RM, Technical, Infra structure, HR, finance, legal and environmental aspects, etc.); The important stages in the production of a new product; the economics of production; Designing and running a chemical plant; energy and mass balances; continuous and batch processes.

Chemical industries:
Manufacture of Sulphuric acid, Ammonia, and Nitric acid; Chlor-alkali industry: The production of chlorine and sodium hydroxide; and the ammonia-soda (Solvay) process.
Chemical based Industries in Sri Lanka:
Existing and potential industries – based on Raw Materials from Natural Resources; Industrial gases and common salt; Mineral based industries: Lime, Cement, Ceramic, Glass and Fertilizer industries; Rubber and rubber- based products, Paper, Tanneries, other (RM source: plants/animals)

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions , Take-home assignments)– 30%
- End Semester Examination – 70%

References:

1. Philip Matthews (2003). Adv. Chemistry: Physical and Industrial. Cambridge university press
2. The Chemical Industry Heaton, C.A (ed), Blackie, Glasgow (1986)
3. Advanced Chemistry: Physical and Industrial Philip Matthews, Cambridge University Press (2003)

Course Title	Separational Techniques in Chemistry			Course Code	CHM 32211		
				Prerequest	-		
Level	3	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	
						Independent Learning (hrs.)	35

Aim of the Course:

To provide advanced knowledge in separational methods and their principles

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the processes involved in chemical separations techniques.
- Apply the underlying principles in qualitative and quantitative analysis.
- Use standard equipment in analytical chemistry.

Course Content:

Introduction: Chromatography, Basic terms, History
Chromatograms: Resolution, Methods for Improving Column Performance, Migration Rates of Solutes, Dead or Void time, Retention Times, Volumetric Flow Rate and Linear Flow Velocity, The Retention Factor, The Selectivity Factor, Band Broadening and Column Efficiency, Types of Columns, Open tubular and packed column; A Quantitative Description of Column Efficiency: Areas under a Gaussian Curve, Determining the Number of Plates in a Column, Variables Affecting column Efficiency, Effect of Mobile-Phase Flow Rate, Theory of Band Broadening, van Deemter equation, The Longitudinal Diffusion Term, Stationary Phase Mass-Transfer Term, Mobile Phase Mass-Transfer Term, Eddy diffusion, Column Resolution, Effect of Retention Factor (k) and Selectivity Factor(α) on Resolution, Optimization Techniques, Variation in the Retention Factor, Variation in Plate Height, Variation in the Selectivity Factor, The General Elution Problem; Mode of Chromatography Separation: Eluotropic Series, Modes of Elution, Classification, Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Mode of Ion exchange chromatography, Liquid Chromatography Detectors, Paper Chromatography, Retention factor Rf, Solvent effect on Rf, Visualization, Common Problems, Types of Paper Chromatography, Thin Layer Chromatography (TLC), HPLC, GC

Mode of Assessment and weightage:

- Continuous Assessment (Short answer questions , Take-home assignments)– 30%
- End Semester Examination – 70%

References:

1. Textbook of quantitative inorganic analysis (A.I. Vogel)
2. Determination of pH: theory and practice (R.G. Bates)
3. Analytical chemistry (J.D. Dick)
4. Chemical separations and measurements: theory and practice (D.G. Peters, J.M. Hayes and G.M. Hieftje).
5. Fundamentals of Analytical Chemistry (Skoog, West and Holler, 7th Ed., 1996, Saunders College Publishing)

Course Title	Biosynthesis of Natural Products			Course Code	CHM 32221		
				Prerequest	-		
Level	3	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	
						Independent Learning (hrs.)	35

Aim of the Course:

To introduce the main classes of natural products, the classification of natural products and to show how they may be biosynthesized and isolated.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe importance of natural products chemistry
- Describe the medical and industrial uses of natural products
- Identify the structural characteristics of the major classes of natural products and recognize their biosynthetic building blocks
- Discuss the important reactions frequently encountered in the biosynthesis
- Identify the natural products and their probable biosynthetic pathways
- Describe the chemistry underlying the methods of isolating natural products

Course Content:

Introduction to Natural Products Chemistry: primary and secondary metabolism, Source of Natural Products, Classification of Natural Products, Isolation techniques, The construction mechanisms of Secondary metabolites: The building blocks Secondary metabolites, important reactions frequently encountered in biosynthesis, Biosynthesis Pathways: Mevalonate pathway, Terpenes: Classes of Terpenes, The Isoprene Rule, Isopentenyl Pyrophosphate biosynthesis, Terpene Biosynthesis; Cholesterol, Vitamin D, Bile Acids, Corticosteroids, Sex Hormones, Carotenoids Acetate pathway: (Eg: Phenols Fatty acids, Prostaglandins, Macrolide antibiotics), Fatty Acid Biosynthesis, Polyketides. Shikimic acid pathway: biosynthesis of coumarins, biosynthesis of warfarin, biosynthesis of flavonoids, biosynthesis of alkaloids, biosynthesis of coumarins

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions , Take-home assignments) - 30%
- End Semester Examination – 70%

References:

1. Torssell, K.B.G, Chemistry Natural Products: A mechanistic, Biosythetic and Ecological Approach, 2nd Edition, USA: Taylor & Francis: 1997.
2. Raymond Cooper, George icola, Natural Products Chemistry, CRC Press, Taylor & Francis, 2015
3. O.P. Agarwal, Chemistry of Organic Natural Products, Vol I & II, Goel Publishing House, 1988
4. S.W. Pelletier, Van Nostrand, Chemistry of Alkaloids, Reinhold, 1970
5. G. Chatwal, Organic Chemistry of Natural Products, Vol. I & II, Himalaya Publishing House, 1988

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Environmental Chemistry</td><td>Course Code</td><td colspan="3">CHM 32231</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td></td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
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Aim of the Course:

To provide the student with an understanding of the earth's natural chemical processes in air, water and soil with special attention to the chemical aspects of environmental disturbances that humans have provoked in the natural environment. It will also include a discussion of current environmental problems, their associated health effects and their solutions.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify the basic concept, terms, and important events in the development of environmental chemistry.
- Identify the stages and draw flow diagrams to describe the respective cycles.
- Explain the structure of the atmosphere.
- Define important chemical processes in the stratosphere and troposphere.
- Distinguish the difference between the primary and secondary air pollutants
- Describe the chemistry of ozone in the troposphere and write balanced chemical equations and mechanism for the ozone depletion.
- Explain the basic difference between the classical smog and the photochemical smog.
- Discuss the causes and effects of acid rain.
- Discuss the role of greenhouse gases on global warming.
- Discuss the issues (causes and effects) related to indoor air pollution.
- Write chemical equations for water acting as an acid and as a base.
- Analyse how aquatic chemistry principles can be applied in natural water resources (and in treatment of drinking water and wastewater).
- Recognize the basis of setting standards for water quality parameters
- Use the basic principles of chemistry for the evaluation of water quality.
- Describe the chemical compositions of natural waters and explain how and why these compositions vary.
- Explain the main sources of water pollution, the main types of pollutants and how each type may be controlled.
- Outline the processes used to treat water for a public water supply.
- Identify the factors causing soil pollution
- Describe the role of industry, agriculture, municipals, hospitals and kitchens play in contributing to various forms of environmental pollution.
- Understand the biological / health effects of environmental pollutants and permissible exposures to certain chemicals.
- Assess the economic loss and explain the ill effects of various environmental pollutions to the eco system.
- Access and interpret materials safety data sheets (MSDSs)

Course Content:

Introduction: Our environment (of earth) and its components. **Atmospheric chemistry components, layers & their characters, Air Pollution:** Air pollutants – I ry & IIry Pollutants, Ozone layer depletion, Smog - Classical and photochemical, Acid rain, Particulate matter, Global warming (G-H effect), Indoor air pollution.
Aquatic chemistry: properties of water, sources (water bodies), Water quality, standards, Water pollutants - Chemical, physical and biological, Water treatment - drinking water, Geo-Chemical cycles: C, N, S, P, and metals.
Other forms of Environmental Pollution: soil, sound/noise, solid waste, kitchen/domestic, hospital/clinical

Mode of Assessment and weightage:

- Continuous Assessment (MCQ , Short answer questions , Take-home assignments, Essay type examination)– 40%
- End Semester Examination – 60%

References:

1. Stanley E. Manahan, Fundamentals of Environmental Chemistry, 3rd ed., Taylor & Francis/CRC Press, 2009
2. Ian Williams (2001). Environmental Chemistry, A modular Approach. John Wiley & Sons, Ltd., Chichester, England
3. G. W. van Loon and S. J. Duffy (2000). Environmental Chemistry; a global perspective. Oxford University Press, Oxford. 492pp.
4. Fifield, F. W. and Haines, P.J. Environmental Analytical Chemistry. Blackwell Science, Oxford, 490 pp.
5. Wagner, R.E. et al., Editors (1996) Guide to Environmental Analytical Methods, 3rd. Ed., Genium Publishing Corp., Schenectady. >100pp.
6. Howard, A.G. (1998) Aquatic Environmental Chemistry. Oxford Science, Oxford. 90pp.
7. Samir K Banerji (1993). Environmental Chemistry, Prentice-Hall of India Private Limited, New Delhi
8. Garrels, R.M. and Christ, C.L. (1965) Solutions, Minerals, and Equilibria. Freeman, Cooper & Co., San Francisco. 450pp.

Course Title	Practical Chemistry VI			Course Code	CHM 32241		
				Prerequest	-		
Level	3	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

To give hands on training on analyzing certain environmental parameters (in the laboratory) and providing some real environment exposure (through field trip).

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Apply proper laboratory practices including safety, waste management, and record keeping
- Describe how wastes are created in the environment (during the different stages of product creation by chemical and physical processes).
- Discuss how waste products are/can be managed.

Course Content:

Practical: learn to access and interpret materials safety data sheets (MSDSs), Determination of pH, EC, TDS, TSS, Determination of anions/nutrients (chloride, nitrate, nitrite, phosphate, …….) and cations/heavy metals, Hardness measurements – EDTA Method, DO - Winkler method, Tests for air pollutants (CO_2, SO_2, H_2S, NOx, etc.), Tests for air pollutants (CO_2, SO_2, H_2S, NOx, etc.).

Field visit: At least one visit to a local area of environmentally interested site

Mode of Assessment and weightage:

- Continuous Assessment (Practical examination, Individual Report, Logbook)– 50%
- End Semester Examination – 50%

References:

1. Williamson, K.L. Macro scale and Microscale Organic Experiments. Houghton Mifflin: Boston, 1999
2. Bell, Clark, Ault, Addison "Techniques and Experiments for Organic Chemistry," 5th Ed.; Waveland Press:
3. Taber & Rodig. Organic Chemistry Laboratory – Standard & Microscale Experiments. Saunders College Publishing:
4. Arun Sethi, Lab experiments in organic chemistry, New Age International Publishers.

Computer Science

Course Title	Computer Systems and Digital Organization			Course Code	CSM 11211		
				Prerequest	-		
Level	1	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students with the basic concepts in Computer System and Digital Organization

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the fundamental parts and peripheral of the computer systems.
- Describe the basics of software, hardware and network devices and its functions.
- Explain the Von Neumann Architecture of computer, factors affecting the computer performance, different types of general-purpose computers, embedded and single board computers.
- Compare the memory hierarchy and usage, and describe gates and circuits.
- Solve Boolean expression using Boolean Algebra and Karnaugh maps (K-maps)
- Compare and contrast combination and sequential circuits.

Course Content:

Introduction to Computer, Computer Peripherals, The Von Neumann Architecture of Computer.
Computer Performance, Memory Hierarchy, Moor's Law, Software and Hardware.
Introduction to single board computer (Eg: Raspberry Pi).
Number Systems: Conversion Among Bases.
Boolean Algebra & Circuit Simplification: DeMorgan's Theorem, Canonical Expression, Karnaugh maps (K-maps) etc.,
Components of digital circuits: Combination & Sequential Circuits, Half adder & Full Adder, Multiplexer, DeMultiplexer, Flip Flop, Counter, Register and Memory.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Mid-term) – 30%
- End Semester Examination-70%

References:

1. The Essential of Computer Organization & Architecture", By: Linda Null & Julia Lobur (2015)
2. Computer Architecture, 5th Edition, By: John Hennessy & David Patterson (2016)

Course Title	Programming & Programming Languages			Course Code	CSM 11222		
				Prerequest	-		
Level	1	Semester	I	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with the basic concepts in programming and programming languages

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand syntax and semantics of a higher-level language in Python and Java.
- Identify and describe uses of variables primitive date types in Python and Java.
- Design, implement, test, and debug Python and Java programs that use each of the following fundamental programming constructs: basic computation, simple I/O, strings, standard conditional and iterative structures, functions and parameter passing.
- Write a program that uses file I/O to provide persistence across multiple executions.
- Choose appropriate conditional and iteration constructs for a given programming task.
- Identify the base case and general case of a recursively-defined problem.
- Handle files in Python and Java.
- Discuss the object-oriented programming fundamentals using Python and Java.
- Use a programming language to implement, test, and debug algorithms for solving simple problems.

Course Content:

Basic syntax and semantics of a higher-level language (Eg: Python and Java). Introduction to Python Programming: Variables and primitive data types in Python, Basic functions and parameter passing in Python, Strings, Lists & Dictionaries in Python, Conditional and iterative controls structures in Python, File handling in Python, Object oriented programming fundamentals using Python.

Introduction to Java Programming: Variables and primitive data types (e.g., numbers, characters, Booleans), Expressions and assignments, Simple I/O including files I/O, Conditional and iterative controls structures, Functions and parameter passing, recursion.

Object oriented programming fundamentals using Java: classes: fields, methods and constructors.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Mid-term) – 30%
- End Semester Examination-70%

References:

1. Java: The Complete Reference, Eight edition by Herbert Schildt, Tata McGraw-Hill Edition 2011.
2. Introduction to Programming using Python, Y. Daniel Liang, Pearson, 2013.
3. Computer Program Design by Elizabeth A Dickson, Tata McGraw-Hill Edition 2002.

Course Title	Programming Practical			Course Code	CSM 11231		
				Prerequest	CSM 11222		
Level	1	Semester	I	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

To provide student with the basic skills in Java and Python programming

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the basic programming concept, Python and Java editors, compilers, interpreter, IDEs (Eg: Netbeans, Eclipse, Anaconda, Jupitor, Spider)
- Distinguish programming constructs: variables, constants, data types, strings, lists, data structure, expressions and assignments.
- Demonstrate parameter passing and returning values in a function.
- Implement programmes using conditional and iterative structures, recursion.
- Demonstrate to pass simple I/O including files I/O by reading and writing
- Develop Object oriented programmes using simple objects and methods. Among different classes.

Course Content:

Introduction to Python and Java editors and IDEs (Eg: NetBeans, Eclipse, Anaconda, Jupiter, Spider etc.).
Java and Python Programming constructs: variables, constants, data types, strings, lists, data structure, expressions and assignments.
Functions and parameter passing in Python & Java.
Programming using conditional and iterative structures (If condition, and loops) in Python & Java; Recursion programming.
Programming to read and write input and files in Python & Java. (Simple I/O including files I/O).
Object oriented programming fundamentals using class, objects and methods.
Object oriented programming fundamentals using Java & Python: classes, fields, methods and constructors.
Object-oriented programming concepts: encapsulation, inheritance and polymorphism.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Practical Assignments) – 50%
- End Semester Examination – 50%

References:

1. Java The Complete Reference", 11th Edition By: Herbert Schildt
2. Head First Java'', 2nd Edition, By: Bert Bates and Kathy Sierra
3. Introduction to Programming using Python, Y. Daniel Liang, Pearson, 2013.

Course Title	Object-Oriented System Analysis and Design			Course Code	CSM 12211		
				Prerequest	CSM 11222, CSM11231		
Level	1	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide student with the basic concepts in Object oriented analysis and design

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand different information systems, development life cycle and roles of each state holder in information system.
- Apply fact gathering techniques for an information system design and development.
- Differentiate different design paradigms: structured and object-oriented design.
- Use tools for structured analysis: data flow diagrams, information flow diagrams, activity diagrams, entity relationship diagrams, document flow diagrams, resource flow diagrams etc.
- Demonstrate Object-Oriented analysis and design by using UML diagrams: class diagram, sequences diagrams, use-case diagram etc.

Course Content:

Introduction to information systems and system analyst roles, SDLC;
Characteristics of OO systems: Classes, Objects, Methods, Encapsulation, Information Hiding, Inheritance, Polymorphism and Dynamic Binding;
Fact gathering techniques: interviews, questionnaires, record inspection and observation, data capture, input verification and control;
Overview of Design Paradigms: Structured design (top-down functional decomposition), object-oriented design;
Tools for structured analysis: data flow diagrams, data dictionaries, Information flow diagrams activity Trigger diagrams, ER diagrams, DFD, resource flow diagrams;
Tools for structured design: structure charts, hierarchical input, output;
Object-Oriented analysis and design: Event driven, Use-Case, Component-level design, data-structured centered, Aspect oriented, function & service oriented, divide and conquer, Architecture-centric, Iterative and Incremental;
Object-oriented design: Decomposition into objects carrying state and having behavior, Class-hierarchy design for modeling;
Tools for object-oriented design: UML Diagrams, Relationship between requirements and designs: Refactoring designs and the use of design patterns;
Fundamental of Object-oriented design: Encapsulation, classes and objects, information hiding, operator overloading, inheritance, overriding, delegation.

Mode of Assessment and weightage:

- Continuous Assessments (Quizzes, Assignments, Mid-term)-30%
- End Semester Examination – 70%

References:

1. Systems Analysis and Design: An Object-Oriented Approach with UML, Alan Dennis, Barbara Wixom, David Tegarden, 6th Edition, ISBN: 978-1-119-56121-7.
2. System Analysis and Design Methods by Jeffrey L. Whitten, Lonnie D. Bentley 7th Edition. ISBN 0- 07-058224-6, Tata McGraw-Hill, 2007.
3. Object-Oriented Analysis and Design with Applications (3rd Edition), Grady Booch and Robert A. Maksimchuk.
4. Systems Analysis and Design: An Object-Oriented Approach with UML, Alan Dennis and Barbara Haley Wixom.
5. UML User Guide", Grady Booch, James Rumbaugh, Ivar Jacobson, Addison Wesley, 2nd Edition, 2005.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Object Oriented Programming</td><td>Course Code</td><td colspan="3">CSM 12222</td></tr>
<tr><td>Prerequest</td><td colspan="3">CSM 11222, CSM 12211</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hrs.)</td><td>30</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>70</td></tr>
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Aim of the Course:

To provide student with the basic concepts in Object oriented programming

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define classes, fields, methods, and constructors in Java/Python
- Use sub classes to design simple class hierarchies that allow code to be reused for distinct subclasses.
- Correctly reason about control flow in a program using dynamic dispatch.
- Explain the relationship between object-oriented inheritance (code-sharing and overriding) and sub typing.
- Use multiple encapsulation mechanisms, such as function closures, object-oriented interfaces, and support for abstract data types, in multiple programming languages.

Course Content:

Object oriented programming fundamentals using Java/Python;
Definition of classes: fields, methods, and constructors, subclasses, inheritance, and method overriding;
Dynamic dispatch: Definition of method –call Sub typing, Subtype polymorphism; implicitly up casts in the type's languages;
Notion of behavioral replacement: subtype acting like super types; Relationship between subtype and inheritance, Object-Oriented idioms for encapsulation, Privacy and visibility of class members; Interfaces revealing only method signatures;
Abstraction base class, using collection classes, iterations, and other common library components;
The use of components, in the design: components and pattern, components and objects, (for example build a GUI using a standard widget set);
Problems analysis, determine objects that are necessary to model the system and determine what attributes the objects need to have, determine what behaviors the objects need to exhibit, conceptual models development, designs from the models generation, and the models implementation.

Mode of Assessment and weightage:

- Continuous Assessments (Quizzes, Assignments, Mid-term)-30%
- End Semester Examination – 70%

References:

1. Object-Oriented Programming with Java: An Introduction, David Barnes, 1st Edition, 2000, ISBN 0130869007.
2. An Introduction to Object-Oriented Programming with Java, Fifth Edition, C. Thomas Wu, Higher Education, 2008.
3. Java The Complete Reference", 11th Edition By: Herbert Schildt
4. Head First Java'', 2nd Edition, By: Bert Bates and Kathy Sierra

Course Title	Object Oriented Programming Practical			Course Code	CSM12231		
				Prerequest	CSM 12211, CSM 12222		
Level	1	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

To provide student with the basic skills in Object Oriented programming

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the basic concept of objects, classes, fields, methods, and constructors. Implement the object-oriented programming concepts: encapsulation, inheritance and polymorphism.
- Demonstrate sub classes to design simple class hierarchies that allow code to be reused for distinct sub classes.

Course Content:

Implementation of programs with object-oriented language constructs using Python/Java, Classes and Objects; Definition of classes: fields, methods, and constructors; Programming constructs: Subclasses, inheritance, Aggregation, Composition, Polymorphism and method overriding, Dynamic dispatch: Sub typing Subtype polymorphism.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Practical exam) – 50%
- End Semester Examination – 50%

References:

1. Java The Complete Reference", 11th Edition By: Herbert Schildt
2. Head First Java'', 2nd Edition, By: Bert Bates and Kathy Sierra.
3. An Introduction to Object-Oriented Programming with Java, Fifth Edition, C. Thomas Wu, Higher Education, 2008.

Course Title	Data structures, Algorithms and Complexity Analysis			Course Code	CSM 21212		
				Prerequest	CSM 11222, CSM 12222		
Level	2	Semester	I	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with conventional and advance algorithms with complexity analysis

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define Big O notation with best", "average", and "worst" case behavior of an algorithms
- Analyse the algorithm in terms of time and space complexity.
- Explain complexity classes of algorithm such as constant, logarithmic, linear, quadratic and exponential.
- Give examples that illustrate time-space trade-offs of algorithms
- Analyse sorting, searching and Hashing Algorithms in terms of Time complexity, big O notation.
- Explain the algorithms implementation and design paradigms such as Divide & Conquer, Dynamic programming, Brute-force, Greedy and Recursive algorithms to solve problems.
- Implement Arrays, lists: linked list, ordered linked list, and doubly linked list; push down stacks; queues: FIFO queue and deque.
- Demonstrate Tree, Graphs and Hashing implementation.

Course Content:

Big O notation: Formation definition, Complexity classes, such as constant, logarithmic, linear, quadratic and exponential, Empirical measurement of performance, Time and space trade-offs in algorithms, Analysis of Algorithms, Time complexity, big O notation. Sorting Algorithms: bubble sort, selection sort, insertion sort, quick sort, heap sort, merge sort and external sorting methods; Searching Algorithms: Binary and sequential search, Hashing: hash functions and collision resolution: separate chaining, linear probing and double hashing.

Classification of Algorithms by implementation and design paradigm (Algorithm Strategies): Divide & Conquer Algorithms, Dynamic Programming, Brute-force algorithms, Greedy Algorithms, Recursive Algorithms and Backtracking, Alfa-Beta pruning, Branch & Bound Search.

Data Structures & Algorithms: Linear and non-linear data structures. Arrays, lists: linked list, ordered linked list, and doubly linked list; push down stacks; queues: FIFO queue and deque.

Tree structures – trees in general, binary search tree (BST), root insertion to BST, splay tree, radix tree and red-black tree.

Graphs-Implementation of depth first search, breadth first search.

Hashing: initial hash, collisions, separate chaining, Simple numerical algorithms, such as computing the average of a list of numbers, finding the min, max and mode in a list, approximating the square roots of a number, or greatest common divisor.

Sequential and binary search algorithms: Worst case quadratic sorting algorithms (Selection, Insertion worst or average case 0 (N log N).
Sorting algorithm: (quicksort, heapsort, merge sort), Hash table, including strategies for avoiding and resolving collisions.
Binary search trees: Common operations on binary search trees such as select min, max, insert, delete iterate over tree, Graph (topological Sort)

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, assignments, Presentation, Mid-term,) -30%
- End Semester Examination-70%

References:

1. Data Structure and Algorithm in Java by Adam Drozdek, Thomson learning, 2nd Edition, 2006 ISBN: 81-315-0107-8.
2. Data Structure and Algorithm in java by the Robert Lafore, GC Join for TechMedia, 2nd edition, ISBN: 817635-186-5.

Course Title	Operating Systems			Course Code	CSM 21221		
				Prerequest	CSM 11211		
Level	2	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course provides an understanding of entire process within Operating Systems. It covers overview of Operating Systems, Operating System principles, memory management, security and protection, device management and file systems.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the concept of Operating System in terms of functionality, mechanism and design issues.
- Understand the knowledge of Operating System principles, security and protection,
- Understand the internal structure of the Operating System: monolithic, layered, modular, micro-kernel models.
- Differentiate process management, memory management and device management.
- Explain the file system organization
- Explain the evolution of the hardware/software techniques.
- Understand the Concept of user/system state and protection, transition to kernel mode.

Course Content:

Overview of Operating Systems, Role, purpose and functionality of a typical operating system, Mechanisms to support client-server models, hand-held devices.
Design issues: efficiency, robustness, flexibility, portability, security, compatibility. Influences of security, networking, multimedia, windows, Operating System Principles. Structuring methods: monolithic, layered, modular, micro-kernel models;
Abstractions, processes, and resources, Process management, memory management and file system;
Concepts of application program interfaces (APIs), Application needs and the evolution of hardware/software techniques;
Device organization and management, Interrupts: methods and implementations, Concept of user/system state and protection, transition to kernel mode.

Mode of Assessment and weightage:

- Continuous Assessment (Test, Assignments, Tutorials) - 30%
- End Semester Examination – 70%

References:

1. Andrew S. Tanenbaum (2015), Modern Operating Systems, 4th Edition
2. William Stallings (2018), Operating Systems: Internals and Design Principles, 9th Edition

Course Title	Advanced Algorithms Practical			Course Code	CSM 21231		
				Prerequest	CSM 21212		
Level	2	Semester	I	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

To provide skill of Advanced Algorithms and their implementation using Java program

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the concept of Data Structures: Arrays, Linked Lists, Stack and Queue.
- Implement the basic operations to the above data structures.
- Understand and distinguish different sorting algorithms along with their implementation in Java
- Understand and implement tree and graph data structures.

Course Content:

Data structure & algorithm implementation using Java/ Python; Implementation of Basic and ADT data Structures; Arrays, Linked Lists, Stack, Queue;
Implementation of Sorting Algorithms: Selection Sort, Insertion Sor, Bubble Sort, Quick Sort and Merge Sort;
Implementation of Searching Algorithms;
Implementation of advanced data structures, Tree, Graph, Hash Table.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Presentation) - 50%
- End Semester Examination – 50%

References:

1. Data Structures and Algorithms in Java, by Waite, Mitchell and Robert Lafore. Techmedia (1999)
2. Head First Java, by Sierra, Kathy and Bates, 2nd edition, Shroff Publishers & Distributors Pvt.Ltd (2005)

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Server-side Web Programming and Web Services</td><td>Course Code</td><td colspan="3">CSM 22211</td></tr>
<tr><td>Prerequest</td><td colspan="3">CSM 11211, CSM 11222</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
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Aim of the Course:

The course is designed to provide the knowledge of web application development techniques; client-side (HTML, JavaScript, CSS) and server-side programming (PHP, MySQL database connection).
Improving students' skills and project-based experience are needed for web design and development careers using a variety of frameworks and tools.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the concept of Data Structures: Arrays, Linked Lists, Stack and Queue.
- Implement the basic operations to the above data structures.
- Understand and distinguish different sorting algorithms along with their implementation in Java
- Understand and implement tree and graph data structures.

Course Content:

Web Technologies: HTTP protocol, Presentation abstractions, Web-markup and display languages, Emerging technologies, Standards & standards bodies.
Introduction to Client-Side Scripting: HTML, Java Script: JavaScript syntax, JavaScript object model, JavaScript objects, Static objects, Forms object (Submit () and Reset () methods);
Event handling - Mouse related events, Keyboard events, Document events, Output in JavaScript, Use SQL & ADO to Interact with ASP.net Databases, Write Cookies on the Client Using ASP.net J2EE.
Server-Side Web Programming: Java Enterprise Edition; JDBC, JSP, Servlet, Hypertext Preprocessor; Program structure, Use PHP to process html forms, Regular expressions for form validation and other applications, Read and write files, Database applications.
Introduction to web services: SOAP WSDL UDDI, importance of Web Services, the evolution of web applications, Web services and enterprises.
XML Fundamentals: XML; Understand the role of XML, Write XSL Documents to Describe how XML Documents are to HTML, Create Simple DTD & Schema Files to Describe the Grammar of XML, Differences between DTD's & Schema, Differences between Cascading Style Sheets & XSL, Other new trends in Web development; Eg. SOAP, WSDL

Mode of Assessment and weightage:

- Continuous Assessment (Quiz, Assignments, Mini projects) - 30%
- End Semester Examination – 70%

References:

1. Developing Enterprise Web Services - An Architect's Guide – Sandeep Chatterjee, James Webber, Pearson Education– Second Indian Reprint 2005.
2. Understanding SOA with Web Services, Eric Newcomer, Greg Lomow, Pearson Education, First Indian Reprint 2005.
3. Benoit Marchal (1999/2001). XML by Example (1st or 2nd Edition). Que Publishers.
4. PHP: A BEGINNER'S GUIDE, Vikram Vaswani, Aug 31, 2008, McGraw Hill.
5. James Fuller et. al. (2003). Professional PHP Web Services. Wrox Press (Indian Edition: Shroff Publishers)

Course Title	Data Communication, Mobile Computing & Internet of Things			Course Code	CSM 22222		
				Prerequest	CSM 21221, CSM 11222		
Level	2	Semester	II	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

The course is designed to provide knowledge in conceptual and technological aspects behind Computer networking, mobile computing and Internet of Things. The major areas include data communication, computer networks, LAN architectures, structure of Internet, Routing, Internet Protocols, network management, wireless LANs, mobile computing basics and IOT fundamentals.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand fundamental principles of Networking, network topologies, Medium Access Control Methods, LAN, WAN, PANs, HiperLAN standards.
- Differentiate different layered architecture, ISO/OSI Model and Roles of the different layers.
- Explain Internet & TCP/IP Protocols,
- Apply Naming and IP address schemes
- Demonstrate switching and routing technologies.
- Understand basic concept in mobile computing such as properties, structure and operation of wireless PANs, LANs, WANs.
- Develop a working knowledge of the networking environments and use this knowledge to explore various applications.
- Differentiate GSM, GPRS network structure and Next generation wireless overview (5G).
- Explain the concept of Mobile IPv4 and Mobile IPv6.
- Understand IOT device architecture and related applications.
- Implement smart systems using IOT devices

Course Content:

Examples and concepts of layered architecture; Overview of higher layer protocols.
LAN - Network Topologies, Medium Access Control Methods, LAN Standards and WAN.
Introduction to ISO/OSI Model, Roles of the different layers (application, transport, network, data link, physical).
Example technologies at the physical/link layers: PANs - Bluetooth. LANs - IEEE802.11, HiperLAN, Introduction to Internet & TCP/IP Protocols, Transport layer.
Internet addressing and Internet protocols; socket interface, Network layer, Taxonomies; relevant parameters of network and traffic, Multiple-access methods for broadcast networks.
Naming and address schemes (DNS, IP addresses (IPv4 & IPv6), Uniform Resource Identifiers, etc.), Switched networks-architectures of switches; scheduling and admission control, Routing-flow control and congestion control.

Interconnections of networks Logical data link protocols.
Introduction to Mobile Computing: Properties of wireless PANs (Bluetooth, Zigbee), LANs, WANs: Basic structure and operation. Adhoc and infrastructure networks. Physical constraints and limitations (transmission & reception). Network structures and architectures, including hand-off and mobility support at the physical/link level, Basic GSM and GPRS (2G/2.5G) network structure and protocol architecture, Next generation wireless overview (5G).
Mobile IP: Mobile IPv4 and Mobile IPv6.
Problems with routing, QoS and Security, Overview of use of intelligence in mobile systems: Power management, replication, adaptation etc.
Internet of Things: Introduction to IOT devices, architecture & applications, Practical implementation of systems using IOT devices

Mode of Assessment and weightage:

- Continuous Assessment (Quiz, Assignments, Tutorials) - 30%
- End Semester Examination – 70%

References:

1. Computer Networks, Author: Tanenbaum A S, Prentice-Hall
2. Data and Computer Communication, Author: Stallings
3. Data communication and Networking Author: Behrouz A. Forouzan
4. Todd Lammle (2011), "CCNA Cisco Certified Network Associate Study Guide", 7th Edition, ISBN-10: 0470901071.
5. Gil Held (2000), "Cisco Router Performance Field Guide",ISBN :81-76-56-887-2

Course Title	Web Programming, Networking and IOT Practical			Course Code	CSM 22231		
				Prerequest	CSM 22211, CSM 22222		
Level	2	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

To provide hands on practical in implementation of web applications and internet and IOT technologies.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Learn the concepts used in internet programming.
- Write well-structured, easily maintained, standards-compliant, accessible HTML code to create simple web pages.
- Write well-structured CSS, JavaScript to add dynamic content and apply client-side logics
- Use PHP for server-side scripting with database technologies to store persistent data for a web application and
- Use PHP framework using Laravel.
- Develop responsive web design using Bootstrap and content management system using WordPress or similar framework.
- Develop a website for an organization (mini project)
- Understand networking commands for troubleshooting.
- Use basics of Cisco Packet Tracer.
- Create networks, switch & router configuration using Packet Tracer simulation and physical implementation.
- Demonstrate a simple networking setup for a laboratory using physical devices.
- Understand Android & IOT based devices, sensors and applications.
- Demonstrate Web, Mobile and IOT based Software development using latest industrial frameworks (Eg: React, Angular, Django, Bootstrap, Laravel, and/or any other current industrial framework)

Course Content:

Server-side web programming: CSS's role in creating user interfaces and JavaScript constructs, PHP for server-side scripting & PHP connect to MySQL database;
PHP framework using Laravel, Responsive web design using Bootstrap; Content management system (Eg: WordPress), Mini project-Web development for an organization.
Data communication: Cabling fundamentals and demonstration of cross over cabling & straight-through cabling.
Networking commands for troubleshooting.
Basics of Cisco Packet Tracer; Create different networks with switch & router; Router configuration using Packet Tracer simulation and physical demonstration using networking devices (cables, Routers, Switches and PCs).
Mobile Computing & IOT: Android & IOT based simple system development, Mini projects using IOT devices.

Web, Mobile and IOT based Software development using latest industrial platforms (Eg: React, Angular, Django, Bootstrap, Laravel, and/or any other current industrial platforms)

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Mini projects) - 50%
- End Semester Examination – 50%

References:

1. Practical PHP: The Definitive Guide to Programming PHP, Paul Hudson, 1 edition (October 28, 2013); Tuxradar.com (2014, updated continuously)
2. Learning JavaScript Design Patterns: A JavaScript and jQuery Developer's Guide, Addy Osmani, O'Reilly Media; 1 edition (August 27, 2012); eBook (2017)

Course Title	Software Engineering			Course Code	CSM 31212		
				Prerequest	-		
Level	3	Semester	I	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

Understand fundamental principles of Software Engineering by providing a broad understanding of the software engineering process, concepts, requirement engineering, systematic development and management of software projects.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe fundamental concepts and trends that provide the context of software system analysis, design and development methods.
- Describe software process models and apply them to solve different problem scenarios.
- Explain requirement engineering processes by analyzing and evaluating system demands.
- Prepare Object Oriented Analysis and Design documents for a given problem using Unified Modelling Language.
- Construct software using standard practices and different programming paradigms.
- Demonstrate system testing and maintenance.
- Design a project plan by analyzing requirements, cost and resource constraints and maintain the software.

Course Content:

Software Processes: Introduction to software process models (e.g., waterfall, incremental, agile), Phases of software life-cycles, Applying software process models.
Requirements Engineering: Properties of requirements including consistency, validity, completeness, and feasibility, Feasibility analysis of software system, describing functional requirements using, for example, use cases or users' stories, Software requirements elicitation, Non-functional requirements and their relationship to software quality, describing system data using, class diagrams or entity-relationship diagrams, Evaluation and use of requirements specifications.
Object-Oriented Design: Use-Case modeling, Class modeling, Dynamic modeling. Object-Oriented Design, Sequence diagram, Collaboration diagram and detailed class diagram, Implementation, integration and maintenance, Computer assisted software engineering (CASE) tools.
Software Construction: Coding practices: techniques, idioms/patterns, mechanisms for building quality programs, Defensive coding practices, Secure coding practices, Exception handling mechanisms to make programs more robust, fault-tolerant Coding standards
Software Verification and Validation: Verification and validation concepts, Inspections, reviews, audits, testing types, including HCI, usability, reliability, security, conformance to specification, testing fundamentals: Unit, integration, validation, and system testing Test plan creation and test case generation Black-box and white-box testing techniques,

Defect tracking, Software maintenance.
Software Project Management: cost, time, resource management, Factors affecting software projects, Software project management tools: PERT chart, Gantt chart, Risk Analysis

Mode of Assessment and weightage:

- Continuous Assessment (Quiz, Written test, Assignments, Software development mini projects) - 30%
- End Semester Examination – 70%

References:

1. Roger Pressman, Software Engineering: A Practitioner's Approach, 5th edition,
2. Laboratory work: Computer programming on workstations.
3. Sara Baase, Allen Van Gelder (2003), Computer Algorithms. Introduction to Design and Analysis. Third Edition, ISBN 81-7808-171-7.
4. Object Oriented Modeling and Design, Author: Raumbugh.
5. Ali Bahrami, "Object Oriented Systems Development", Tata McGraw-Hill.

Course Title	Database Management System			Course Code	CSM 31221		
				Prerequest	-		
Level	3	Semester	I	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course aims to provide knowledge in components of a database system, major DBMS functions, data modelling, Query languages (SQL), relational and non-relational database design.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the role of a database system and the functions of a database administrator,
- Explain the three-schema architecture for databases and thus the difference between conceptual, external and physical schemas,
- Understand the database application development process,
- Construct SQL queries as a data definition language, data manipulation language and access control language and
- Develop a database application and integrate with software projects.
- Apply the concept of normalization in database system
- Differentiate relational and non-relational databases and their design principles.

Course Content:

Information Management Concepts: Information management applications, Declarative and navigational queries, use of links, Analysis and indexing, Quality issues: Reliability, scalability, efficiency, and effectiveness.

Database Systems: Approaches to and evolution of database systems, Components of database systems, Design of core DBMS functions (e.g., query mechanisms, transaction management, buffer management, access methods), Database architecture and data independence, Use of a declarative query language, Systems supporting structured and/or stream content, Approaches for managing large volumes of data (e.g., MySQL database systems, use of MapReduce).

Data Modelling: Conceptual models (e.g., entity-relationship, UML diagrams), Spread sheet models, Relational data models, Object-oriented models, Semi-structured data model (expressed using DTD or XML Schema, for example).

Relational Databases: Mapping conceptual schema to a relational schema, Entity and referential integrity, Relational algebra and relational calculus, Relational database design, Functional dependency, Decomposition of a schema; lossless-join and dependency-preservation properties of a decomposition Normalization, Candidate keys, super keys, and closure of a set of attributes, Normal forms (BCNF), Multi-valued dependency (2NF), Join dependency (PJNF, 3NF), Representation theory Query Languages.

Non-relational databases: Non-relational databases using MongoDB, Query processing in non-relational databases.

Overview of database languages: SQL (data definition, query formulation, data manipulation and data control language).

Mode of Assessment and weightage:

- Continuous Assessment (Written test, Assignments, DBMS Mini projects) - 30%
- End Semester Examination – 70%

References:

1. Database system concepts 5th edition by Silberschatz
2. Elmasri and Navathe, Fundamentals of Database Systems
3. Advanced Database Systems (Lecture Notes in Computer Science) by: Nabil R. Adam, Bharat K. Bhargava.
4. Advanced Database Technology and Design (Artech House Computer Library), Mario Piattini.

Course Title	DBMS Practical			Course Code	CSM 31231		
				Prerequest	CSM 31221		
Level	3	Semester	I	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

The course aims to provide practical experience in database, data modelling, relational and non-relational database design, Query languages (SQL for data definition, data manipulation and access control.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the database application development process,
- Construct SQL queries as a data definition language, data manipulation language and access control language and
- Develop a database application and integrate with software projects. (Eg: JDBC Connection)
- Design relational and non-relational databases using ORACLE, MySql and Mongo DB.

Course Content:

Database Systems: Approaches to and evolution of database systems, Components of database systems, Design of core DBMS functions (e.g., query mechanisms, transaction management, buffer management, access methods), Use of a declarative query language, Approaches for managing large volumes of data (e.g., MySQL database systems, use of MapReduce).

Data Modelling: Conceptual models (e.g., entity-relationship, UML diagrams), Relational data models, Object-oriented models, Semi-structured data model (expressed using DTD or XML Schema, for example), Relational Databases Design, Mapping conceptual schema to a relational schema, Entity and referential integrity, Relational database design.

Non-relational databases: Non-relational database design using MongoDB, Query processing in non-relational databases.

Overview of database languages: SQL for data definition, query formulation, data manipulation and data control.

Mode of Assessment and weightage:

- Continuous Assessment (Written test, Assignments, DBMS Mini projects) - 50%
- End Semester Examination – 50%

References:

1. Database system concepts 5th edition by Silberschatz
2. Elmasri and Navathe, Fundamentals of Database Systems
3. Advanced Database Systems (Lecture Notes in Computer Science) by: Nabil R.Adam, Bharat K. Bhargava.
4. Advanced Database Technology and Design (Artech House Computer Library), Mario Piattini.

Course Title	Machine Learning & Data Science			Course Code	CSM 32212		
				Prerequest	-		
Level	3	Semester	II	Credits	2	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide Student with fundamental concepts in Machine Learning and Data Science

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain common machine learning methods and their applications.
- Define and differentiate supervised versus unsupervised learning.
- Use classical regression and classification methods.
- Construct algorithms for linear models, supervised learning models, unsupervised learning models.
- Analyze supervised and unsupervised learning models using datasets.
- Explain performance metrics of data analysis.
- Apply data science processes in a sample dataset.
- Analyze data and machine learning techniques for estimation and prediction.
- Demonstrate with data analysis tools and environments.
- Perform data transformations, explorations, visualization, and analysis.
- Visualize information, redesign
- Collect data, analyses data and communication. scientific questions

Course Content:

Introduction to machine learning and Data Science; Common machine learning methods and their applications; Introduction to supervised versus unsupervised learning; Exploration of alternatives to classical regression and classification;
Introduction to models: Generalized linear models, algorithmic models (e.g., regression trees and Naïve bays, Nearest neighbors);
Unsupervised learning: clustering & principal component analysis; Algorithmic analysis of models; Performance metrics; prediction and cross validation.
Introduction to Data science: Data and Image models, Data Science process, Describing data, information visualization & redesign, Data preprocessing, exploratory data analysis (EDA).
Machine learning approaches for estimation and prediction.
Tools and environments to perform data transformations, explorations, visualization, and analysis;
Scaling for big data, Data in context-Capstone experience with scientific questions, collect and analyse data and communication.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, assignments, Mini projects, Mid-term,) -30%
- End Semester Examination-70%

References:

1. Data Mining and Machine Learning: Fundamental Concepts and Algorithms 2nd Edition, Mohammed J. Zaki, 2020.
2. Machine Learning and Data Mining, Igor Kononenko, 2007

Course Title	Digital Image Processing			Course Code	CSM 32221		
				Prerequest	-		
Level	3	Semester	II	Credits	1	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide student with advance image processing insights.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify the applications of digital image processing.
- Represent 2D, 3D and higher dimensional images.
- Describe fundamental aspects in image processing: elements of visual perception, light and electro-magnetic spectrum, image sensing, sampling and quantization, pixels relationship etc.
- Demonstrate morphological image processing techniques: erosion, dilation, opening, closing, hit-or-miss transform, gray scale morphology.
- Understand in-depth theories in image transformations: histogram processing and spatial filtering.
- Describe 2D Fourier transform, Fast Fourier Transform, Inverse FFT, Discrete Cosine Transform in frequency domain.
- Use Discrete Wavelet Transforms in image compression.
- Demonstrate image segmentation using point, line and edges, threshold, region-based segmentation, boundary descriptors and regional descriptors.

Course Content:

Introduction to digital images: why digital images, the digital camera, data types and 2D, 3D and higher dimensional representations.
Fundamental steps in digital image processing, elements of visual perception, light and electro-magnetic spectrum, image sensing and acquisition, sampling and quantization, relationships between pixels.
Morphological image processing: erosion, dilation, opening, closing, hit-or-miss transform, gray scale morphology.
Image Transformations: histogram processing, spatial filtering, fuzzy techniques. Filtering in the frequency domain: 2D Fourier transform (Fast Fourier Transform, Inverse FFT, Discrete Cosine Transform), Discrete Wavelet Transforms and its application in compression.
Image segmentation: point, line and edge detection, threshold, region-based segmentation. Representation and description: boundary descriptors, regional descriptors.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, Assignments, Mid-term exam,) -30%
- End Semester Examination-70%

References:

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th Edition, 2019.

Course Title	Image Processing Practical			Course Code	CSM 32231		
				Prerequest	CSM 32221		
Level	3	Semester	II	Credits	1	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

To provide student with advance image processing hands on practical experience.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Represent images in MATLAB and/or Octave / Open CV (open source) platforms.
- Read, display, write, and process, histogram of images.
- Apply morphological image processing techniques such as erosion, dilation, opening, closing, hit-or-miss transform, gray scale to RGB and RGB to gray scale conversion.
- Apply image enhancement techniques such as point and algebraic operations, edge detection and sharpening.
- Demonstrate filtering techniques in spatial and transformed domains.
- Segment images based on points, lines, edge detection, boundary descriptors and regional descriptors.
- Develop a mini project/assignment using MATLAB/Octave/Open CV platform for a simple image processing application.

Course Content:

Digital image representations using MATLAB and/or Octave / Open CV (open source), Reading, displaying and writing images, Histogram processing, Morphological image processing: erosion, dilation, opening, closing, hit-or-miss transform, gray scale morphology.

Image Enhancement: Point and algebraic operations, edge detection and sharpening, filtering in the spatial and transformed domains.

Image segmentation - point, line and edge detection, Boundary descriptors, regional descriptors.

Mini project/assignment using MATLAB/Octave/Open CV.

Mode of Assessment and weightage:

- Continuous Assessment (Quizzes, assignments, Mini project, Mid-term practical exam) -50%
- End Semester Examination-50%

References:

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th Edition, 2019.

Earth Science

Course Title	Dynamic Earth			Course Code	ESM 11212		
				Prerequest	-		
Level	1	Semester	I	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

The course aims to provide students with the basic concepts of Earth's origin and its dynamics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe how the solar system and the earth are being evolved
- Compare the compositional and structural differences within the layers of the concentric Earth
- Explain how the super continent of Pangea was broken, continents and oceans were developed, and earthquakes and volcanoes are operated
- Distinguish processes in geological and human time scales
- Describe the volcanism and plutonism.

Course Content:

Introduction to Earth Science, Introduction to Solar system and the Earth, Origin of the Solar system, Structure and composition of the Earth, Continental drifting, sea floor spreading and plate tectonic theories, Geological time scale, Earth's Internal processes; volcanism, plutonism

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Skinner, B. J., Porter, S. C., & Botkin, D. B. (1994). Blue Planet: An Introduction to Earth System Science. Laboratory Manual. John Wiley & Sons.
2. Skinner, B. J., Porter, S. C., Park, J. J., & Levin, H. L. (2004). Dynamic Earth: An introduction to physical geology.
3. Press, F., Siever, R., Grotzinger, J., & Jordan, T. H. (2004). Understanding earth. Macmillan.

Course Title	Earth Processes			Course Code	ESM 11221		
				Prerequest	-		
Level	1	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course aims to provide students with the basic concepts in internal and external Earth processes

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Distinguish exogenic processes from endogenic processes
- Understand the weathering, erosion, deposition and structural processes in landscape development
- Explain the theories of mass movement as an Earth shaping process

Course Content:

Exogenic versus endogenic processes, Physical and chemical weathering processes, Processes of erosional and depositional actions of rivers, glaciers, wind and waves, Formation of different types of exogenic landforms, Process of mass movement

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Blatt, H. (1997). Our geologic environment. Prentice Hall.
2. Bierman, P. R. (2014). Key concepts in geomorphology/Paul R. bierman y David R. Montgomery (No. 551.41 B54.).
3. Craig, J. R., Vaughan, D. J., & Skinner, B. J. (2011). Earth resources and the environment. Pearson Prentice Hall. Global Geomorphology 1st Ed., by Michael A. Summerfield
4. Maloof, T. (2014). Weathering and Erosion. Teacher Created Materials.
5. Murck, B. W., Skinner, B. J., Porter, S. C., & Mortimer, Z. (1998). Dangerous Earth. An Introduction to Geologic Hazards. Pure and Applied Geophysics, 152(1).

Course Title	Practical in Fundamental Geology			Course Code	ESM 11231		
				Prerequest	-		
Level	1	Semester	I	Credits	01	Theory (hrs.)	-
						Practical/Field (hrs.)	45
						Independent Learning (hrs.)	5

Aim of the Course:

The course aims to provide students with basic understandings of fundamental of topographic and geological mapping

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify components of a topographic map
- Produce a topographic profile for a given area
- Interpret the topographic maps for relief/geomorphological features and drainage patterns of a given terrain
- Identify components of a geology map
- Produce a geological cross section for a given terrain and to interpret subsurface geology
- Interpret the geological history of a given terrain

Course Content:

Introduction to Mapping, Components of topographic maps, Producing a topographic cross section, Relief/geomorphological features, Drainage patterns, Geology Maps, Geological cross section, Geological history of a terrain

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

1. Barnes, J. W., & Lisle, R. J. (2013). Basic geological mapping. John Wiley & Sons.
2. Bennison, G. M., Olver, P. A., & Moseley, K. A. (2013). An introduction to geological structures and maps. Routledge.
3. Skinner, B. J., Porter, S. C., Park, J. J., & Levin, H. L. (2004). Dynamic Earth: An introduction to physical geology.
4. Summerfield, M. A. (2014). Global geomorphology. Routledge.
5. Tearpock, D. J., & Bischke, R. (2002). Applied subsurface geological mapping (p. 864). New Jersey: Prentice Hall.

Course Title	Earth Materials (Rocks, minerals, crystals)			Course Code	ESM 12212		
				Prerequest	-		
Level	1	Semester	II	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

The course aims to provide the student with the basic knowledge on minerals, crystallography and rocks

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify common minerals with respect to their physicochemical properties
- Identify and categorize common rock types with respect to formation mechanisms
- Differentiate minerals and rocks
- Classify the different types of minerals
- Identify the system and class of a minerals based on its symmetry
- Identify the given crystal forms and their miller indices

Course Content:

Introduction to minerals and types of rocks with their formation mechanisms, Physicochemical properties of minerals, Basic classifications of minerals, Silicates and non- silicate minerals, Common rock-forming minerals, Classification of minerals and rocks, Introduction to crystallography, Bravais lattice, Symmetry elements, Mineral forms and habits, Crystallographic systems and classes, Millar indices, Twinning of crystals

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Blatt, H. and Tracy, R.J. (1996). Petrology- Igneous, Sedimentary, and Metamorphic Rocks. W.H. Freeman, NY.
2. Dana, E. S. (1898). A text-book of mineralogy: With an extended treatise on crystallography and physical mineralogy. Wiley.
3. Deer, W.A., Howie, R.A. and Zussman, J. (1993). An Introduction to Rock Forming Minerals. 2nd Edition, John Wiley and Sons, NY.
4. Klein, C. Jr. and Hurlbut, C.S. (1993). Manual of Mineralogy. Willey, NY.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Optical Mineralogy</td><td>Course Code</td><td colspan="3">ESM 12221</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
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Aim of the Course:

The course aims to provide the student with the basic knowledge on Optical Mineralogy

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the optical behavior of minerals.
- Distinguish common rock forming minerals based on the principles of optical mineralogy.

Course Content:

Introduction to Petrographic microscope, Snell 's Law on reflection and refraction, polarized light, Double refraction, isotropy and anisotropy, Uniaxial and biaxial minerals and their indicatrices.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Gribble, C.D. and Hall, A.J. (1985). A Practical Introduction to Optical Mineralogy. George Allen and Unwin, London.
2. Kerr, Paul F. (1959). Optical Mineralogy. McGraw-Hill, London
3. Deer, W.A., Howie, R.A. and Zussman, J. (1993). An Introduction to Rock Forming Minerals. 2nd Edition, John Wiley and Sons, NY.

Course Title	Practical in Crystallography and Mineralogy			Course Code	ESM 12231		
				Prerequest	-		
Level	1	Semester	II	Credits	01	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

This course is aimed to provide students with the practical identifications of minerals based on crystallographic concepts.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify the system and class of a mineral based on its symmetry
- Identify the given crystal forms and their miller indices
- Handle the petrographic microscope competently in mineral identification
- Identify basic rock forming minerals using polarizing microscope and their physical properties.

Course Content:

Mineral forms and habits, Crystallographic systems and classes, Millar indices, Identification of basic optical properties of common rock forming minerals, Identification of common rock forming minerals using their physical properties.

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

1. Glazer, A.M., (2016). Crystallography: A very short introduction (Vol. 469). Oxford University Press.
2. Gribble, C.D. and Hall, A.J. (1985). A Practical Introduction to Optical Mineralogy. George Allen and Unwin, London.
3. Kerr, Paul F. (1959). Optical Mineralogy. McGraw-Hill, London
   Klein, C. Jr. Hurlbut, C.S., Dana, J.D. (1993). Manual of Mineralogy. Willey, NY.

Course Title	Petrology			Course Code	ESM 21213		
				Prerequest	-		
Level	2	Semester	I	Credits	03	Theory (hrs.)	45
						Practical (hrs.)	-
						Independent Learning (hrs.)	105

Aim of the Course:

The course aims to provide students with comprehensive knowledge in igneous, sedimentary, and metamorphic rocks.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- List the major minerals that make up igneous, sedimentary and metamorphic rocks.
- Describe the textures and structures found in igneous, sedimentary and metamorphic rocks
- Name different types of igneous, sedimentary and metamorphic rocks by means of their composition and texture.
- Interpret petrogenesis of different types of igneous, sedimentary and metamorphic rocks.
- Infer different environments for the formation of igneous, sedimentary and metamorphic rocks.

Course Content:

Introduction to igneous rocks, Different types of magma, Types of igneous rocks, Genesis of igneous rocks, Minerals and textures of igneous rocks, Chemical constituents of igneous rocks, IUGS classification of igneous rocks, Introduction to Sedimentary rocks, Origin of sedimentary rocks, Different types of sedimentary rocks, Textural and mineralogical classification of sedimentary rocks, Depositional environments, Introduction to metamorphic rocks, Process of metamorphism, Metamorphic facies concept, Metamorphic minerals, Metamorphic phase equilibrium, Metamorphic fabrics, Common metamorphic rock types, Nomenclature of metamorphic rocks, Field characteristics of common Sri Lankan rocks.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Blatt, H., Tracy, R., & Owens, B. (2006). Petrology: igneous, sedimentary, and metamorphic. Macmillan.
2. Bucher, K., & Grapes, R. (2011). Petrogenesis of metamorphic rocks. Springer Science & Business Media.
3. Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks. McGraw-Hill Science, Engineering & Mathematics.
4. Sen, G. (2013). Petrology: Principles and practice. Springer Science & Business Media.

5. Spear, F. S.(1995). Metamorphic phase equilibria and pressure-temperature-time paths.
6. Yardley, B. W., & Yardley, B. W. D. (1989). An introduction to metamorphic petrology (Vol. 248). Harlow: Longman Scientific & Technical.

Course Title	Practical in Petrology			Course Code	ESM 21221		
				Prerequest	-		
Level	2	Semester	I	Credits	01	Theory (hrs.)	-
						Practical/Field (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

The course aims to provide students with comprehensive knowledge identification of major igneous, sedimentary, and metamorphic rocks.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify the major minerals that make up igneous, sedimentary and metamorphic rocks.
- Identify the textures and structures found in igneous, sedimentary and metamorphic rocks
- Name different types of igneous, sedimentary and metamorphic rocks by means of their composition and texture.
- Interpret the different environments for the formation of igneous, sedimentary and metamorphic rocks.

Course Content:

Textures and composition of clastic, chemical and biogenic sedimentary rocks, Classification of clastic rocks according to Pettejohn's classification, Textures and mineralogy of foliated and non-foliated metamorphic rocks, Classification of metamorphic rocks according to mineralogical classification, Textures of specific metamorphic rocks, Textures and mineralogy of Extrusive and Intrusive igneous rocks, Classification of Igneous rocks using IUGS classification, Textures of common sedimentary, igneous and metamorphic rocks under petrographic microscope.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, Lab report) – 50%
- End Semester Examination – 50%

References:

1. Blatt, H., Tracy, R., & Owens, B. (2006). Petrology: igneous, sedimentary, and metamorphic. Macmillan.
2. Bucher, K., & Grapes, R. (2011). Petrogenesis of metamorphic rocks. Springer Science & Business Media.
3. Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks. McGraw-Hill Science, Engineering & Mathematics.
4. Sen, G. (2013). Petrology: Principles and practice. Springer Science & Business Media.
5. Yardley, B. W., & Yardley, B. W. D. (1989). An introduction to metamorphic petrology (Vol. 248). Harlow: Longman Scientific & Technical.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Geochemistry</td><td>Course Code</td><td colspan="3">ESM 22211</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
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Aim of the Course:

This course is aimed to provide students with basic concepts of geochemistry

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate basic principles of geochemistry and their applications to geological studies
- Differentiate the elemental abundances in extraterrestrial and terrestrial systems
- Describe element distribution in major rocks and minerals

Course Content:

Introduction to geochemistry, Differentiation of cosmic abundance of elements, Chemical behavior of different classes of elements, Trace element, Chemistry of igneous, metamorphic and sedimentary rocks

Mode of Assessment and weightage:

- Continuous Assessment (written exam, Assignment) – 30%
- End Semester Examination – 70%

References:

1. Albarède, F. (2009). Geochemistry: an introduction. Cambridge University Press.
2. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2003). Geochemistry: Pathways and processes. Columbia University Press.
3. Misra, K. C. (2012). Introduction to geochemistry: principles and applications. John Wiley & Sons.
4. White, W. M. (2013). Geochemistry. John Wiley & Sons.

Course Title	Structural Geology			Course Code	ESM 22222		
				Prerequest	-		
Level	2	Semester	II	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

This course aims to provide students with the theoretical principles of structural geology.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the different types of geological structures
- Describe the evolution process of geological structures considering stress fields
- Interpret basic structures with the aid of stereographic projections
- Classify geological structures considering global tectonic environments.

Course Content:

Different types of deformation and tectonic events, Introduction to types of geological structures/features (folds, faults, joints, foliation, lineation, compositional layers, rock contacts, etc.), Basics of stereographic projection of structural data, Interpretation of geological structures using stress fields.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Fossen, H. (2016). Structural geology. Cambridge University Press.
2. Kearey, P., Klepeis, K. A., & Vine, F. J. (2009). Global tectonics. John Wiley & Sons.
3. Mukherjee, S. (Ed.). (2015). Atlas of structural geology. Elsevier.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Tectonics and Field Geology</td><td>Course Code</td><td colspan="3">ESM 22231</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical/Field (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>05</td></tr>
</table>

Aim of the Course:

This course aims to Tectonics and Field Geology

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify rock types/geological features/ geological structurers in the field
- Measure geological structures/features
- Analyze basic structures with the aid of stereographic projections
- Compile a detail geological map following the standards

Course Content:

Identify and interpret the geological structures in the field, measuring of strike and dip of geological structures in the field, plotting field measurements in a field map, Stereographic projections and their applications, Compile a standard geological map.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Lab report) – 50%
- End Semester Examination – 50%

References:

1. Coe, A. L. (Ed.). (2010). Geological field techniques. John Wiley & Sons.
2. Kearey, P., Klepeis, K. A., & Vine, F. J. (2009). Global tectonics. John Wiley & Sons.
3. Mathur, S. M. (2001). Guide to Field Geology. PHI Learning Pvt. Ltd.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Engineering Geology and Mechanics of Earth Materials</td><td>Course Code</td><td colspan="3">ESM 31212</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>90</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>10</td></tr>
</table>

Aim of the Course:

This course is aimed to provide the students with the applications of geological knowledge in engineering practices and the basic concepts in soil and rock mechanics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe the significance of geology in geotechnical applications
- Apply basic tests to characterize engineering properties of rocks
- Demonstrate the applications of engineering geological concepts in engineering practices
- Apply basic laboratory tests to characterize the soils and rocks
- Classify the soils and rocks based on their mechanical properties
- Investigate the suitability of rocks and soils for engineering applications

Course Content:

Geotechnical characteristics of earth materials, Weathering grade and rock mass classification systems, Strength and failure of rocks, Stress and strain, Rock Testing, Slope stability, Underground excavations, Ground improvements and foundations, Applications of engineering geology in common engineering structures, Soil and rock classifications for engineering purposes, Index relations of soils, Factors influencing compaction of soil and Rock

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

1. Das, B. M., & Sobhan, K. (2013). Principles of geotechnical engineering. Cengage learning.
2. Goodman, R. (1993). Engineering geology.
3. Goodman, R. E. (1989). Introduction to rock mechanics (Vol. 2). New York: Wiley.
4. Kehew, A. E. (1995). Geology for engineers and environmental scientists. Pearson College Division.
5. McCarthy, D. F. (1977). Essentials of soil mechanics and foundations (p. 505). Virginia: Reston Publishing Company.
6. West, T. R. (2010). Geology applied to engineering. Waveland Press.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Exploration Geophysics</td><td>Course Code</td><td colspan="3">ESM 31221</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

To provide the students with the geophysical applications for geological explorations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain geophysical properties of earth materials
- Apply geophysical methods to geological resource explorations

Course Content:

Introduction to geophysics, Geophysical properties earth materials, Seismology (Seismic waves, Earthquake seismology), Seismic imaging (reflection, refraction, etc.), The seismometer, Earth gravity, Mass distribution and relation to gravity, Gravity anomalies, The gravimeter, Introduction to ground penetrating radar and electrical methods, Geophysical explorations and their limitations

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Buforn, E., Pro, C., Udías, A., & Vallina, A. U. (2012). Solved problems in Geophysics. Cambridge University Press.
2. Lowrie, W., & Fichtner, A. (2019). Fundamentals of geophysics. Cambridge university press.
3. Parasnis, D. S. (2012). Principles of applied geophysics. Springer Science & Business Media.
4. Robert, J. L. (1999). Whole Earth Geophysics (An Introductory Textbook for Geologists and Geophysicists).

Course Title	Engineering Tastings in Earth Materials			Course Code	ESM 31231		
				Prerequest	-		
Level	3	Semester	I	Credits	01	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

The course aims to provide the students with the experiences on the basic laboratory testing in soil and rock mechanics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Apply basic tests to characterize engineering properties of rocks
- Apply basic laboratory tests to characterize the soils and rocks
- Classify the soils and rocks based on their mechanical properties
- Investigate the suitability of rocks and soils for engineering applications

Course Content:

Physical properties of soils and rocks, Grain size distribution and aggregate properties of soil, Laboratory tests in compaction of soil and rock, Stress distribution in soils and rocks, Measurement of strength parameters and deformation behavior of rocks and soils

Mode of Assessment and weightage:

- Continuous Assessment (Lab reports) – 50%
- End Semester Examination – 50%

References:

1. Goodman, R. (1993). Engineering geology.
2. Goodman, R. E. (1989). Introduction to rock mechanics (Vol. 2). New York: Wiley.
3. Kehew, A. E. (1995). Geology for engineers and environmental scientists. Pearson College Division.
4. McCarthy, D. F. (1977). Essentials of soil mechanics and foundations (p. 505). Virginia: Reston Publishing Company.
5. West, T. R. (2010). Geology applied to engineering. Waveland Press.

Course Title	Geology of Sri Lanka			Course Code	ESM 32212		
				Prerequest	-		
Level	3	Semester	II	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

This course is aimed to provide students with comprehensive knowledge in Geology of Sri Lanka

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify different rock types and structures found in Sri Lankan terrain
- Describe the genesis of different rock types
- Explain the geological, structural and geomorphological evolution of Sri Lanka
- Identify mineral deposits and interpret their potential industrial applications

Course Content:

Rock types, tectonics, and geomorphology of Sri Lanka, Development of faulted basins, Jurassic sedimentary rocks, Miocene beds, Quaternary formations, Metamorphic rocks and major subdivisions, Cooling history, Metamorphic conditions and exhumation of metamorphic rocks, Igneous rocks and their genesis, Geochemistry of Sri Lankan rocks, Economic mineral deposits, Deformational events and structures in the crystalline terrain, Geological and tectonic evolution of Sri Lanka

Mode of Assessment and weightage:

- Continuous Assessment (Written exam, Assignment) – 30%
- End Semester Examination – 70%

References:

1. Cooray, P. G. (1984). An introduction to the geology of Sri Lanka (Ceylon) (Vol. 38). National museums of Sri Lanka publication.
2. Cooray, P. G. (1994). The Precambrian of Sri Lanka: a historical review. Precambrian research, 66(1-4), 3-18.
3. Kehelpannala, K. V. W. (2003). Structural evolution of the middle to lower crust in Sri Lanka-a review.
4. Kehelpannala, K. W. (2004). Arc accretion around Sri Lanka during the assembly of Gondwana. Gondwana Research, 7(4S), 41-46.
5. Kroner, A. (1991). The Crystalline Crust of Sri Lanka, Part I. Summary and Research of the German-Sri Lanka Consortium. Geological Survey Department, Sri Lanka, Professional Paper, 5, 5-21.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Hydrology and Hydrogeology</td><td>Course Code</td><td colspan="3">ESM 32221</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

This course is to provide the students with the basic concepts of hydrology and hydrogeology.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe the surface and subsurface distribution of water
- Distinguish common hydrological parameters
- Distinguish different types of aquifers
- Estimate the aquifer properties

Course Content:

Introduction to hydrological cycle, Earth's water budget, Water balance study for a basin considering precipitation, surface runoff, infiltration, groundwater flow and evapotranspiration processes, Characterization of streams and basins, Groundwater in distribution saturated and unsaturated zone, Darcy's law for groundwater flow, Basic aquifer properties, principle types of aquifers.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Hiscock, K. M. (2009). Hydrogeology: principles and practice. John Wiley & Sons.
2. Hudak, P. F. (2004). Principles of hydrogeology. CRC Press.
3. Serrano, S. E. (2010). Hydrology for engineers, geologists, and environmental professionals. Hydro Science.
4. Viessman, W., & Lewis, G. L. (1996). Introduction to hydrology. New York: HarperCollins.

Course Title	Practical in Hydrology and Hydrogeology			Course Code	ESM 32231		
				Prerequest	-		
Level	3	Semester	II	Credits	01	Theory (hrs.)	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

This course is to provide the students with the practical applications of hydrology and hydrogeology.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Execute a groundwater exploration task in a selected area
- Distinguish aquifer types and their properties in the field
- Estimate the surface runoff of a stream channel
- Analyze a river basin using hydrological parameters

Course Content:

Precipitation data interpretations. Surface runoff estimations, River basin analysis, Porosity and permeability as basic aquifer properties, Seismic and geo electric methods for groundwater explorations.

Mode of Assessment and weightage:

- Continuous Assessment (Lab reports) – 50%
- End Semester Examination – 50%

References:

1. Hiscock, K. M. (2009). Hydrogeology: principles and practice. John Wiley & Sons.
2. Hudak, P. F. (2004). Principles of hydrogeology. CRC Press.
3. Serrano, S. E. (2010). Hydrology for engineers, geologists, and environmental professionals. Hydro Science.
4. Viessman, W., & Lewis, G. L. (1996). Introduction to hydrology. New York: HarperCollins.

Higher Mathematics

Course Title	Graph Theory			**Course Code**	HMM 11212		
				Prerequest			
Level	1	**Semester**	I	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To provide a thorough introduction to the subject of graph theory and to make aware of advanced methods from structural graph theory.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Define the terms related to graph theory.
2. Compute basic numerical quantities associated to graph theory.
3. Prove and interpret the fundamental results in graph theory.
4. Use presented graph theory methods in other areas of mathematics.

Course Content:

Introduction of Graphs, Representing Graphs, Graphs Isomorphism, Types of Graphs, Union, Complement and product of Graphs, Connectivity, Eulerian Graphs, Hamiltonian Graphs, Weighted Graphs and their Applications, The Chinese Postman problem and the Travelling Salesman problem.

Introduction to trees, Applications of trees, Tree Traversals, Spanning Trees, Minimum Weighted Spanning Trees, Planar Graphs, Euler's Formula, Dual Graphs, Coloring Graphs, Map Coloring, Edge Coloring.

Time table Scheduling, Directed Graphs, Isomorphism of Digraphs and other Properties, Application of Directed Graphs and Tournaments, Line Graph, Line graphs and Traversability, Cut points, Bridges and Blocks, Hall's Marriage Theorem, Transversal Theory, Applications of Hall's Theorem, Manger's Theorem, Network Flows, Factorization,

Introduction to Matroids, Examples of Matroids, Steiner systems, Application of steiner Triple systems, Partitions, Infinite graphs.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. R.Balakrishnan, K.Ranganathan, A Text book of Graph Theory, Springer, 2012;
2. Jonathan L. Gross, Jay Yellen, Graph Theory and Its Applications,Chapman and Hall/CRC; 2005;
3. Douglas B.West,Introduction to Graph Theory, Pearson, 2000.

Course Title	Tensor Calculus			Course Code	HMM 11222		
				Prerequest			
Level	1	Semester	I	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To acquire knowledge of the theory and techniques used in tensors.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate knowledge in basic concepts of tensor calculus required for further studies in general relativity;
2. Perform Fundamental operations with tensor.
3. Explain different types of tensors;
4. Apply the properties of different kind of tensors to solve physical and mathematical problems.

Course Content:

Spaces of N-dimensions, Coordinate transformation, Summation convention, Contravariant, covariant and mixed tensors, Kronecker delta, Scalar or invariant, Tensor field, Fundamental operators with tensor, Symmetric and skew symmetric tensors, Metric tensor and conjugate metric tensor, Associated tensor, Christoffel's symbols, Transformation laws of Christoffel's symbols, Geodesics, Covariant derivative, Tensor form of a gradient, divergent and curl, Intrinsic or absolute derivative, Relative and absolute tensors.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. U. C. De Absos Ali Shaikh JoydeepSengupta, Tensor Calculus, Narosa Publishing House 2004;
2. James G. Simmonds, A Brief on Tensor Analysis, Springer-Verlag, 1994.
3. Nayak, P. K. Textbook of tensor calculus and Differential Geometry. PHI Learning, 2012.

Course Title	Vector Calculus			**Course Code**	HMM 12212		
				Prerequest			
Level	1	**Semester**	II	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To extend the knowledge from the view point of single valued scalar functions to vector valued functions of many variables.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain the concept of infiniticimal calculus of vector functions.
2. Perform vector operations on vector or scalar functions.
3. Apply knowledge of the operations of a vector function to describe physical phenominan.
4. State and apply the integral theorems to solve physical and geometrical problems.

Course Content:

Introduction of Vector function and Scalar function. Differentiation and integration of vector functions;

Space curves; Tangent and normal; Scalar and vector fields; Directional derivative; Gradient vector; Divergence; Curl; Vector identities; Scalar potential of conservative fields.

Orthogonal curvilinear coordinates: Coordinate surfaces, Coordinate curves and related unit vectors; Elements of arc length; Area and volume; Cylindrical polar coordinates; Spherical polar coordinates and others.

Line integrals; Path independence. Surface integrals; Green's theorem in the plane. Volume integrals; Divergence theorem; The Curl and Stoke's theorem. Vector potential; Irrotational and solenoidal vector fields; Laplace's equation and its simple solutions.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Murray R. Spiegel, Vector Analysis, 2nd edition, McGraw-Hill, 2009;
2. Shanti Narayan, Text book of vector calculus, S. Chand & Company Ltd., 2003;
3. M.D. Raisinghaniya, Vector Analysis, S. Chand & Company Ltd.,1997.

Course Title	Differential Geometry			**Course Code**	HMM 12222		
				Prerequest	MTM 11222		
Level	1	**Semester**	II	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To describe how techniques from advanced calculus and vector algebra may be used to give meaning to the concept of "shape" for curves and surfaces in space.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Define the basic terms related to differential geometry of space curves and planes.
2. State and prove the selected theorems on differential geometry
3. Apply the relevant theorems to solve geometrical problems.
4. Find the equations of various types lines, curves and surfaces that occur in differential geometry.

Course Content:

Introduction, Parameterized curves, Arc-length, Re-parameterization of a curve. Moving triads of lines and planes. Serret-Frenet formulae. Osculating circle, Involutes and evolutes, Helices.
Parameterized surfaces (patches), Regular surfaces. Tangent plane, Surface normal.
One parametric family of surfaces: envelopes, edge of regressions, Developable surfaces; The first and the second Fundamental forms, Asymptotic curves, Principal curvatures, Mean and Gaussian curvatures, Skew surfaces, Minimal surfaces, Lines of curvature.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Somasundaram D, Differential Geometry A First Course, Narosa Publishing House, 2005;
2. Shanti Narayan (Revised by P.K.Mittal), A text book of vector calculus, S. Chand & Company Ltd, 2003;
3. John Oprea, Differential Geometry and its Applications, Prentice Hall, 1997.

Course Title	Classical Mechanics			**Course Code**	HMM 21212		
				Prerequest			
Level	2	**Semester**	I	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To develop the skills in the application of the basic laws and methods of classical mechanics to specific physical and mechanical problems

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain the central concepts of classical mechanics, including force, energy, work, momentum, moments of inertia, torque and angular momentum;
2. Discuss the kinematical and dynamical theory of a particle and a rigid body (as a rotating frame;
3. Apply these results to seen and unseen physical situations by using them to set up a mathematical model and to find quantitative solutions;
4. Solve dynamical problems involving classical particles by using the suitable formulations.

Course Content:

Motion of a particle in a plane: Velocity and acceleration components in Cartesian and polar coordinates, Newton's second law: Inertial fame, Coordinates, Impulse-Momentum Integral Work-Energy. Constrained motion: Use of intrinsic coordinates, Dynamics of a system particles: Angular Momentum, Kinetic energy.

Kinematical Motion of a Rigid Body: Transition and rotation motion, infinitesimal displacement of a rigid body, rotating frame of reference (non-inertial frame).

Motion of a particle near the Earth surface: Equation of Motion of a Rigid Body: Equation of motion of a system of particles, Moment of inertia, product of inertia, Euler's equations, Torque free motion of a rigid body, the invariable line and plane, The motion of a symmetrical rigid body, Eulerian angle, The motion of a Heavy symmetrical top

Lagrange's Equation of Motion: Virtual displacement, work, D'Alembert's principle, generalized force, Lagrange's equation, the motion of symmetrical top under.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Herbert Goldstein, Classical Mechanics, Charles P Poole and John Safto Doling Kindsesly (India) Pvt. Ltd., 2008;
2. Gupta, Kumar, Sharma, Classical Mechanics, 1998;
3. V. B. Bhutia, Classical Mechanics, Narosa Publishing House, 1997

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Partial Differential Equations</td><td>Course Code</td><td colspan="3">HMM 21222</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hr)</td><td>30</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

To provide basic knowledge in the theory of partial differential equations and use it to solve boundary value problems those arise in the field of mathematical physics.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Define and classify basic terms related to partial differential equations (PDE).
2. Classify PDEs as per linear, semi-linear, quasi-linear and non-linear.
3. Form a PDE by eliminating arbitrary constants or arbitrary functions.
4. Solve and interpret PDEs by suitable methods.

Course Content:

Introduction: Basic definitions, Classification of equations, Classification of solutions, Formation of partial differential equations.
First order partial differential equations: Linear Equations, Characteristics, Lagrange's equations, Non-linear equations: Charpit's method, Characteristic strips.
Second order equations: Semi-linear equations: Classification, Canonical forms, Linear Equations with constant coefficients: Homogeneous and non-homogeneous equations; Method of separation of variables: Heat equation, Wave equation and Laplace equation. Boundary value problems, use of Fourier series.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Raisinghaniya M. D., Ordinary and Partial Differential Equations, S. Chand and company Ltd. New Delhi.,2008;
2. Amarnath T, An Elementary course in Partial Differential equations, Narosa Publishing House, New Delhi., 2005;
3. K. Sankara Rao, Introduction to Partial Differential Equations, Prentice Hall of India Private Limited, New Delhi, 1997.

Course Title	Group Theory II			**Course Code**	HMM 22211		
				Prerequest	MTM 12221		
Level	2	**Semester**	II	**Credits**	1	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To give a coherent treatment of basic theories and problems from group theory.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. State the basic definitions and statement of group theory.
2. Investigate properties of groups;
3. Apply these properties to solve problems in algebra.

Course Content:

Cosets; Normal subgroups; Quotient groups; Subgroups of a quotient group. Homomorphism; Fundamental theorem of isomomorphism. Center of a group; Commutator; Commutator subgroup; Centralizer; Normalizer; Automorphism

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. John B. Fraleigh, A First Course in Abstract Algebra, Person Education, Inc. 2003;
2. S. Lipschutz& M. L. Lipson, Theory and Problems of Discrete Mathematics, Tata McGraw-Hill Publishing Company Limited, 1999;
3. R. S. Aggarwal, A Text Book on Modern Algebra, S. Chand & Company Ltd, 1996.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Mathematical Software (Mat Lab)</td><td>Course Code</td><td colspan="3">HMM 22221</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td></td></tr>
<tr><td>Practical (hr)</td><td>45</td></tr>
<tr><td>Independent Learning (hr)</td><td>05</td></tr>
</table>

Aim of the Course:

To introduce the students to MATLAB and to give a solid foundation in basic graphical and programming essentials.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Describe the MATLAB desktop,
2. Work with basic mathematical tools, in-built functions.
3. Create and run scripts files and functions.
4. Plot a given set of data and edit the plot.
5. Write simple MATLAB programs.

Course Content:

Getting started with MATLAB, MATLAB windows, Arithmetic with MATLAB, Some elementary build-in functions, variables;
Matrices with MATLAB: Creating matrices, Adding and deleting elements, Some build-in functions, Matrix operations;
MATLAB Files: M–files, Script files, function files;
Graphics: Two dimensional plots, Editing plots, Basic plotting functions, Three dimensional plots;
Programming: Relational and logical operations. Flow controls: if, else if, else; switch and case; for; while.

Mode of Assessment and weightage:

- Continuous Assessment (Practical tests, practicar recordings etc.) – 50%
- End Semester Examination – 50%

References:

1. Amos Gilat, *MATLAB An Introduction With Applications*, John Wiley and Sons, Inc., 2005;
2. Help menu of the software;
3. Online resources.

Course Title	Metric Space			**Course Code**	HMM 22231		
				Prerequest			
Level	2	**Semester**	II	**Credits**	2	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To introduce metric spaces with focusing on continuity and generalization.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain metric spaces with examples and recognize basic properties of metric space;
2. Demonstrate an understanding of notions such as openness, closeness, continuity, limits, completeness, equivalence of metrics as applied in the context of general and specific metric spaces.
3. Drive and apply elementary theorems involving the concepts of metric space, subspace and bases.

Course Content:

Metric spaces, open spheres and closed spheres, Equivalent metrics. Interior points, closed sets, Limit points, closure of a set, Boundary points, Distance between sets and Diameter of a set. Subspace of a metric space, Bases.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Wilson A. Sutherland, Introduction to Metric and Topological Spaces, Oxford University Press, 2009;
2. Pawan K. Jain and Khalil Ahmad, Metric Spaces, Alpha Science International Ltd., 2004.

Course Title	Riemann Integrals and Infinite Series			**Course Code**	HMM 22241		
				Prerequest			
Level	2	**Semester**	II	**Credits**	1	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To provide basic aspects of the Riemann integrations and infinite series.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate knowledge of the basic concepts of Riemann integration.
2. Appraise integrals of real valued function on intervals,
3. Employ the techniques of testing the behavior of infinite series with regard to convergence

Course Content:

Riemann integrations: Upper and Lower Riemann sums; Riemann Integral; Integrability of certain classes of functions; Fundamental theorem of calculus; Improper integrals. Infinite Series: Positive term series, Test for convergence and divergence

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, 2012;
2. Pawan K. Jain and Shiv K. Kaushik, An Introduction to Real Analysis, S. Chand & Company Ltd, 2000.
3. James S. Howland, Basic Real Analysis, Jones and Bartlett Publishers, 2010.

Course Title	Topology			**Course Code**	HMM 31211		
				Prerequest			
Level	3	**Semester**	I	**Credits**	1	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To describe main concepts of topological spaces, continuous functions and homeomorphisms.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate knowledge of topological structure
2. Define basic terms in topology and its constructions
3. Distinguish open and closed subsets and construct closure, interior and boundary points.
4. Construct subspaces, bases, continuity and homeomorphisms.

Course Content:

Definition of Topology and some types of topologies. Some examples, Coaser and finer topology.
Neighborhoods and spaces; Definition and examples, Open and closed sets and their properties, Closure, Interior and Boundary points;
Subspaces; Bases and sub-bases for topology;
Function on between two topological spaces Continuity and homeomorphism

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Seymour Lipschutz ,General Topology, McGraw-Hill Company, New York., 2011;
2. Munkres, J. R., Topology, J. R. Prentice-Hall of India Ltd., New Delhi., 2000;
3. Bert Mendelson, Introduction to Topology, Dover Publications Inc., 1990

Course Title	Function of Several Variables			**Course Code**	HMM 31221		
				Prerequest			
Level	3	**Semester**	I	**Credits**	1	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To give a coherent treatment of basic theories and problems solving techniques from multivariate calculus.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Describe the ideas and concepts for functions of a single variable to functions of several variables
2. Solve the problems in limits, continuity, partial derivatives and extrema for functions of several variables.
3. Compute double integrals

Course Content:

Limits and continuity: Limits of function of two variables; Algebraic properties; Continuity.
Differentiation: Partial derivatives; Total differential; Sufficient condition for differentiability.
Extreme values: Local maxima and minima; Hessian of function; Lagrange multipliers.
Double integrals.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, 2012;
2. C.H. Edwards, Jr., Advanced Calculus of Several Variables, Dover Publications 1994;
3. Wendell Fleming, Functions of Several Variables (Second Ed.), Springer, 1991.

Course Title	Numerical Analysis II			**Course Code**	HMM 31232		
				Prerequest			
Level	3	**Semester**	I	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To enhance the knowledge in the theory and techniques of numerical analysis and skills in solving mathematical problems numerically

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate the knowledge of fundamental material in numerical methods;
2. Solve system of linear equations;
3. Use algorithms and theorems to find numerical solutions and bounds on their error to numerical differentiation and numerical integration.
4. Identify and use proper numerical methods to solve boundary value problems.

Course Content:

Numerical methods of solving system of linear equations: Gaussian elimination and backward substitution, Iterative methods; Jacobi and Gauss - Seidal methods and their convergence.

Numerical Differentiation and Integration: Differentiation formulae for equidistant nodes, Some important approximate quadrature formulae, Newton cotes formulae, Trapezoidal, Simpson and Romberg integration, Error estimates.

Boundary value problems of ordinary differential equations: The linear shooting method, Finite difference method, Collocation method, Finite element method.

Numerical solutions of partial differential equations.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. R. Gupta, Golden Maths Series Numerical Analysis, Laxmi publications (p) ltd, 2011;
2. Devi Prasad, Introduction to Numerical Analysis, Narosa Publishing House, 2005.

Course Title	Fluid Dynamics			**Course Code**	HMM 32212		
				Prerequest			
Level	3	**Semester**	II	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To learn the most basic notions of continuous mechanics and fluid dynamics of an inviscid fluid.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Use the basic mathematical tools for the description of motions of a continuous medium;
2. Formulate the governing equations of fluid dynamics;
3. Solve these equations in simple cases;
4. Explain rational ideas about various fluid flows around us;

Course Content:

Ideal fluid, Equilibrium of a fluid, Kinematics of flow fluids, Continuity equation of motion, Circulations, Euler's equation for fluid motion, Bernoulli's equation, Bara-tropic fluid, Helmholtz equation for velocity vector, Kelvin's circulation theorem, Expanding bubbles, Irrotational motion, Velocity potential, Two-dimensional motion and stream function, Complex potential, Sources, Sinks, Doublets, Vortices, Milne-Thomson theorem, Flow past a cylinder, Flow past a sphere.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Peter S. Bernard, Fluid Dynamics, Cambridge university press, 2015;
2. M.D. Raisinghania, Fluid Dynamics - 5th edition, S Chand & Co Ltd., 2003;
3. G. K. Batchlor, An Introduction to Fluid Dynamics, Cambridge university press, 1967.

Course Title	Operational Research			**Course Code**	HMM 32222		
				Prerequest			
Level	3	**Semester**	II	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To get idea about how to solve any decision-making problem in real life using well organized dicision making and modeling of deterministic and probabilistic system;

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Solve special Linear Programming problem: transportation and networking problem.
2. Solve the problems dealing with repair and maintenance, scheduling and sequencing control of project etc.
3. Allocate recourse to various operations, logistic, movement of personal etc.
4. Make an optimum schedule for any kind of project by using project scheduling models.

Course Content:

Transportation, Mathematical formulation transportation problems. Finding initial basic solutions: North west corner method, least cost method, Vogal's Approximation method simplex method for transportation problems, Assignment problems, Hungarian Algorithm, Mack's Bradford method. Transshipment problems.
Network: Introduction, Maximum flow, shortest path; Project and scheduling using Critical Path Method (CPM) and Project Evaluation Review Techniques (PERT). Crashing in project scheduling

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Hamdy a. Taha, Operations Research: An Introduction, 9th edition, Prentice Hall, 2010;
2. Saul I. Gass, Linear programming methods and Applications,Fifth Edition, Dover Publications, 2010;
3. Wayne L Winston, Introduction to Mathematical Programming, Thomson Learning; 4th edition 2002.

Mathematics

Course Title	Fundamentals of Mathematics			Course Code	MTM 11212		
				Prerequest	---		
Level	1	Semester	I	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To develop fundamental aspects of the set theory and related topics.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate knowledge of the concepts of mathematical logic;
2. Explain methods of proofs which are fundamental in various parts of mathematics.
3. Explain the concept of sets, relations and functions.
4. Apply these concepts to given problems in a proper manner

Course Content:

Symbolic Logic and Proofs: Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Arguments with Quantified Premises, Proof Methods and Strategy.

Set theory: Sets, Operation on sets, Laws connecting these operators, Ordered pairs and Cartesian Products.

Relations: Relations, Equivalence relations. Order relations, Maximum and minimal of ordered sets, Zorn's Lemma.

Functions: Injection, Surjection, Bisection, Invertible and composite functions

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

4. Elliott Mendelson, Introduction to Mathematical Logic, Chapman & Hall/CRC, 1997
5. Chetwynd& P. Diggle, Discrete Mathematics, Butterworth-Heinemann, 1995
6. S. Lipschutz& M. L. Lipson, Theory and Problems of Discrete Mathematics, Tata McGraw-Hill Publishing Company Limited,1999
7. R. S. Aggarwal, A text book on Modern Algebra, S. Chand & Company Ltd, 1973

Course Title	Vector Algebra and Geometry			**Course Code**	MTM 11222		
				Prerequest			
Level	1	**Semester**	I	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To provide students with the opportunity to understand the basic concepts of vector algebra and to build the confidence and skills to apply these concepts in geometrical problems..

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Define the basic terms related to vector algebra;
2. Evaluate vector operations and interpret them geometrically;
3. Derive and interpret various types of equations (parametric, non-parametric, Cartesian, symmetric) of a straight line and a plane;
4. Solve problems related to straight lines and planes by vector methods.

Course Content:

Introduction to vectors: basic definitions, representation of vectors, basic vector operations, direction cosines of a line, section formula.

Products of two vectors: scalar product, vector product, scalar triple product, vector triple product with their Geometrical interpretations. Reciprocal set of vectors.

Lines in space: Collinear vectors. Equations of a line; Angle between two lines, Intersection of two lines, Skew lines, Shortest distance between two lines.

Planes: Coplanar vectors, Equations of a plane. Line of intersection of two planes, Angle between two planes, Point of intersect of a line and a plane, Angle between a line and a plane, Distance of a point from a plane.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Shanti Narayan and Mittal P.K.,A Textbook of Vector analysis, S. Chand & Company Ltd, 2007
2. Murray R. Spiegel, Schaum's outlines –Vector Analysis, McGraw-Hill, 2005
3. M.D. Raisinghania, Vector Analysis, S. Chand & Company Ltd, 1997

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Number Theory</td><td>Course Code</td><td colspan="3">MTM 12211</td></tr>
<tr><td>Prerequest</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To give an introduction to elementary number theory.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain the concept of numbers and their properties;
2. Describe and use the Euclidean algorithm and to explain how to solve linear Diophantine equations;
3. Discuss linear congruence and apply the Chinese remainder theorem to solve problems;

Course Content:

Divisibility: Division algorithm, Greatest common divisors and linear combinations, Bezout's identity, Euclid's algorithm, Linear Diophantine equation, Fundamental theorem of arithmetic.

Modular arithmetic: Linear congruence, System of congruence, Chinese remainder Theorem.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. James E. Pommersheim, Tim K. Marks and Erica L. Flapan, Number Theory, John Wiley & Sons, Inc, 2010
2. George E. Andrews, Number Theory, Dover Publication, Inc., New York, 1971.

Course Title	Group Theory I			**Course Code**	MTM 12221		
				Prerequest			
Level	1	**Semester**	II	**Credits**	1	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To provide elementary knowledge in groups with the experience on classification of groups

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Recognize the fundamental properties of groups and subgroups;
2. Demonstrate knowledge of subgroups, cyclic groups and permutation groups;
3. Derive and apply theorems related to groups, subgroups, cyclic group and permutations to solve the problems.

Course Content:

Binary operations, Groups, Subgroups, Order of a group, Cyclic groups, Permutation groups, Even and odd permutations

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

3. John B. Fraleigh, A First Course in Abstract Algebra, Person Education, Inc., 2003.
4. Thomas A. Whitelaw,Introduction to Abstract Algebra, Springer, 1990.
5. I.N. Herstein, Topics in Algebra, Wiley & Sons, Inc., 1975.

Course Title	Elementary Differential Equations			**Course Code**	MTM 12231		
				Prerequest			
Level	1	**Semester**	II	**Credits**	1	**Theory (hr)**	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To acquire the basic knowledge of differential equations as well as various elementary techniques involved in the solution of the first order ordinary differential equations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate basic knowledge on differential equations (DE) such as defining the basic terms, formation and classification;
2. Solve a given first order DE by an appropriate technique;
3. Model a variety of real-world problems as DE and explain the phenomenon of the resonance.

Course Content:

Introduction to differential equations: Basic definitions, Classification of differential equations, Formation of ordinary differential equations, Solutions of a differential equation.

First order first degree ordinary differential equations: Existence and uniqueness of solutions, Variable Separable equations, Homogeneous equations, Exact equations, Linear equations, Bernoulli's equation, Ricatti's equation, Clairaut's equation, Substitution methods.

Approximation Method: Picard's method

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

3. Raisinghaniya M. D., Ordinary and Partial Differential Equations, S. Chand and company Ltd. New Delhi., 2008
4. Zafar Ahsan, Differential Equations and Their Applications, PHI Learning Pvt. Ltd., 2004
5. Dennis G. Zill, A First Course in Differential Equations with Applications, PWS Publishers., Boston, 1986

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Vector Spaces</td><td>Course Code</td><td colspan="3">MTM 12241</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To familiarize students with the concept of matrix row operations and linear phenomena.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Use row operations and column operations to discuss the consistency of a linear system and find the full set of solutions, if it exists.
2. Determine whether a specified set of vectors forms a vector space / subspace.
3. Find bases and dimension for a vector space.

Course Content:

Row operations and Column operations, Row-echolon forms, System of linear equations.

Vector spaces: Vector Spaces, Subspaces, Spanning set, Direct sum, Linear independence and linear dependence, Maximal independent set, Bases and dimension

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Paul R. Halmos, Finite Dimensional Vector Spaces, Martino Fine Books, Mansfield Centre, 2012
2. Robert M. Thrall and Leonard Tornheim, Vector spaces and Matrices, Dover Publications, INC., New York, 2011
3. Shanti Narayan, P.K. Mittal , A Textbook of Matrices, , S Chand & Co Ltd, New Delhi., 2010

Course Title	Numerical Analysis I			Course Code	MTM 21212		
				Prerequest			
Level	2	Semester	I	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To build a sound platform on concept and techniques of numerical analysis.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Discuss the various types of errors occurred in the numerical calculations;
2. Solve an algebraic, transcendental or differential equation using appropriate numerical methods;
3. Discuss the various types of polynomials used in numerical analysis.
4. Demonstrate interpolating or extrapolating techniques.

Course Content:

Number system and Errors.

Solution of equations in one variable: Bisection method, Fixed-Point iteration, Method of False position, Newton–Raphson Method.

Linear difference equations of first and second order.

Polynomials: Collocation polynomials, Factorial polynomials, Osculating polynomials, Taylor polynomials.

Interpolation: Lagrange interpolation, divided differences, forward and backward difference methods, Errors in interpolation, Extrapolation, Inverse interpolation.

Numerical methods of solving differential equations: Euler method, Linear multi-step method, Taylor method, Runge -Kutta method.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis, PWS Publishing Company, 1993.
2. Curtis F. Gerald and Patrick O. Wheatley,Applied Numerical Analysis, Pearson Education, Inc. 2004.
3. Francis Scheid, Numerical Analysis, Tata McGraw-Hill Publishing Company Ltd., 2004.

Course Title	Ordinary Differential Equations			**Course Code**	MTM 21222		
				Prerequest	MTM 12231		
Level	2	**Semester**	I	**Credits**	2	**Theory (hr)**	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To facilitate the students with the techniques of solving higher order differential equations and the system of firsts order differential equations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Demonstrate the techniques of solving various types of higher order linear differential equations (DE).
2. Solve systems of linear DEs in two or three variables.
3. Find a fundamental set of solutions of a system of linear DEs by eigenvalue method.
4. Sketch phase portrait of the autonomous system and discuss the stability of the solutions.

Course Content:

Higher order linear differential equations; Equations with constant coefficients; Wronskian, *D* operators, Undetermined coefficients, Variation of parameters.

Frobenius series solution,

Total differential equations in three variables, Simultaneous total differential equations.

System of Linear Differential Equations: Eigenvector method, Fundamental matrix solution, exponential matrix.

Non-linear autonomous systems, Phase plane, Phase portraits of linear systems, stability

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Raisinghaniya M. D., Ordinary and Partial Differential Equations, S. Chand and company Ltd. New Delhi., 2008
2. Dennis G. Zill, A First Course in Differential Equations with Applications, PWS Publishers., Boston, 1986
3. H.T.H. Piaggio, Differential Equations, G.Bell and Sons Ltd., 1949

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Real Analysis</td><td>Course Code</td><td colspan="3">MTM 22212</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hr)</td><td>30</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

To introduce Real Analysis which is concerned with the study of the real number system and calculus.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain the key properties of real number system.
2. State, prove and apply the key theorems related to sequences of real numbers;
3. Determine the continuity and differentiability of a function at a point and on a set;
4. Apply properties of continuous functions and differentiable functions to solve simple problems;

Course Content:

Real numbers: The algebraic and order properties, Absolute value and the real line, Completeness property, Applications of the supremum property.

Sequence of real numbers: Sequences and their limits, Convergent sequences, Subsequence and the Bolzano-Weierstrass Theorem, The Cauchy criterion.

Limits: Limits of function, Limit theorems, and some extensions of the limit concepts.

Continuous Functions: Continuous functions, Combination of continuous functions, Continuous functions on intervals.

Differentiation: The derivative, Mean value theorem, L' Hospital rule, Taylors Theorem, maximum and minimum of functions

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Robert G. Bartle and Donald R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, Inc., 2011
2. Charles G. Denlinger, Elements of Real Analysis, Jones and Bardtt Publishers, LLC, 2011
3. Anthony W. Knapp (2016), Basic Real Analysis, ISBN-13 978-0-8176-3250-2

Course Title	Integral Transforms			Course Code	MTM 22222		
				Prerequest			
Level	2	Semester	II	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To encourage a view of Integral transforms as a way of thinking and as tools for problem solvings in many branches of Mathematics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. State the basic terms and properties of integral transforms;
2. Evaluate integral transforms and inverse transforms of functions, if they exist,
3. Apply the method of integral transforms to solve various types of problems in many branches of Mathematics.
4. Demonstrate a given function by expressing as a Fourier integrals or series

Course Content:

Laplace Transforms: Laplace transforms of elementary functions, Basic properties. Inverse Laplace Transforms, Convolution Theorem, Use of special functions, Partial fraction method, Heaviside's expansion method. Applications: Evaluation of certain integrals, Applications in ordinary differential equations, Mechanics and in partial differential equations.

Fourier integral representation, The (Complex) Fourier transforms, Infinite Fourier sine/cosine transforms and their inverse formulae.

Fourier series, Finite Fourier sine/cosine transforms, Inverse formulae using Fourier series, Solution of boundary value problems using Fourier transforms.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Murray R. Spiegel, Schaum's outlines – Laplace Transforms, McGraw–Hill, 2005
2. Raisinghania M. D., Laplace and Fourier Transforms, S. Chand & Company Ltd, 1995
3. Murray R. Spiegel, Schaum's outlines – Fourier Analysis with Application to Boundary Value Problems, McGraw–Hill, 2005

Course Title	Linear Programming			Course Code	MTM 31212		
				Prerequest			
Level	3	Semester	I	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To provide understanding how linear programming is used to find the optimal solution to a problem that requires decisions about how best to use limited resources to achieve a state goal of objectives

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Formulate linear programming problems from contextual problems;
2. Identify feasible regions for linear programming problems;
3. Find solutions to linear programming problems using graphical and simplex methods;
4. Interpret the solutions of linear programming problems.

Course Content:

Linear inequalities; Geometric approach; Feasible solution; Graphical method.

Simplex method: Theory and computational procedure of simplex method; Simplex algorithm. Efficient computational techniques; primal dual relationship, unboundedness, degeneracy, Big-M method. Duality theory, Dual simplex method, Interpretation of the solutions of dual and primal problems, Two phase method, LP problems with unrestricted variables.

Advanced method of LP problem: Revised simplex method. Sensitive analysis

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Hamdy a. Taha, Operations Research: An Introduction, 9th edition, Prentice Hall, 2010
2. Saul I. Gass, Linear programming methods and Applications,Fifth Edition, Dover Publications, 2010
3. Robert J. Vanderbei, Linear programming Foundations and Extensions, 2nd Edition, Springer, 2010

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Mathematical Modeling</td><td>Course Code</td><td colspan="3">MTM 31222</td></tr>
<tr><td>Prerequest</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hr)</td><td>30</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

To educate in the theoretical and practical aspects of mathematical problem solving and mathematical model development

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain how the general principles arise in the context of Mathematical Modeling.
2. Analyze some existing mathematical models and construct meaningful models of simple mechanical, financial, physical and biological system.
3. Formulate, solve and interpret real world problems.

Course Content:

Modeling methodology: Introduction, Definitions and terminology.

Modeling skills: Listing factors, making assumptions, formulating models. Modeling using difference equations for mechanical, financial, physical and biological systems.

Modeling using differential equations for mechanical, financial, physical and biological systems.

Case studies and presentation of models

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Frank R. Giordano, William P. Fox, Steven B. Horton and Maurice D. Weir, A First Course in Mathematical Modeling,Brooks/Cole, Cengage Learning, 2009
2. Dilwyn Edwards and Mike Hamson, Guide 2 Mathematical Modelling, Palgrave, 2007
3. Michael D Alder (2001), An Introduction to Mathematical Modelling

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Complex Analysis</td><td>Course Code</td><td colspan="3">MTM 32212</td></tr>
<tr><td>Prerequest</td><td colspan="3">MTM 22212</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hr)</td><td>30</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

to understand the concept of complex analysis by extending the idea developed in real analysis and apply the methods to solve problems in various fields

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain the concepts of topics in complex analysis;
2. Check for differentiability of a complex function,
3. Evaluate integrals using contour integration by relared theorems;
4. Develop power series and Laurent series expansions of complex-valued functions;

Course Content:

The complex field; Riemann sphere; Topology of the complex plane.

Analytic functions; Cauchy-Riemann equations. Cauchy theorem; Cauchy's integral formulae. Taylor series; Laurent's series.

Complex integration: line integral and some theorems, green's theorem, Cauchy integral formula, Fundamental Theorem of algebra.

Pole and Residue, residue theorem; Evaluation of real-valued integrals by means of residues. Conformal mappings

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Murray R. Spiegel, Seymour Lipschutz, John J. Schiller, and Dennis Spellman, Schaum's Outlines: Complex Variables, McGraw-Hill, 2nd ed., 2009
2. James W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw-Hill, 8th ed., 2009
3. Dennis G Zill and Patrick D Shanahan, A First Course in Complex Analysis with Application, Jones and Bartlett Publishers, 2006

Course Title	Linear Algebra			Course Code	MTM 32222		
				Prerequest			
Level	3	Semester	II	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To improve the basic ideas and techniques of linear algebra and help the students to develop the ability of abstract and critical reasoning in solving problems.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

1. Explain the concept of topics in Linear Algebra.
2. Find the sub spaces and related matrices
3. Explain the notion of a linear transformation and its matrix.
4. Use the eigenvalue and eigenvectors method to solve different type of problems
5. Find and interpret the orthogonal diagonalization of symmetric matrices.

Course Content:

Finite dimensional space; Dimension theorem for vector spaces;

Linear transformations; The Kernel and Range of a Linear Transformation; Singular and non-singular mappings; Matrices for Linear Transformations; Transition Matrices and Similarity; Dimension theorem for linear mapping.

Diagonalizable linear operators; Singular and non- singular linear operators; Eigen values and Eigenvectors of linear operator; Eigen values and Eigenvectors of matrix; Minimum polynomial of matrix; Cayley-Hamilton theorem.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. David. C. Lay, Linear Algebra and Its Applications, Pearson Education, 2010;
2. Fraleigh Beauregard, Linear Algebra, Addison Wesley Publishing Company, 1995.
3. Gilbert Strang (2020), Linear Algebra for Everyone , ISBN 978-1-7331466-3-0

Physics

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">General Physics</td><td>Course Code</td><td colspan="3">PHM 11212</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hrs.)</td><td>30</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>70</td></tr>
</table>

Aim of the Course:

To provide students with basic understanding of the fundamental physical concepts and principles related to mechanics and waves and develop the necessary analytical and mathematical skills on problem solving that will be applicable to diverse situations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define and describe inertial frames and inertial forces, and solve numerical problems.
- Understand the Newton's Laws of Motion and apply them to simple physical systems.
- Explain the Law of Conservation of Energy, Conservation of Momentum and apply it to simple mechanical systems.
- Explain the Rotational dynamics and Fluid mechanics, and apply them to simple physical systems.
- Define and describe Simple Harmonic Vibrations and solve numerical problems in vibrations.
- Describe progress waves and wave equation and demonstrate their applications in problem solving.
- Describe the characteristics and properties of waves.

Course Content:

Forces of nature: Gravitation, Electromagnetic, Weak and nuclear Forces.

Inertia and Motion: Principle of inertia, Newton's Laws, Inertial mass and gravitational mass, Inertial frames, Galilean Transformation, Accelerating frames.

Inertial Force**:** Centrifugal and Coriolis force, Accelerating frames and gravity, Principle of Equivalence, Weightlessness.

Energy and Momentum: Work and energy, Conservation of energy, Conservation of force, Linear momentum, Conservation of linear momentum, Force due to loss of momentum.

Rotational Dynamics: Angular momentum, Torque, Moment of inertia, Conservation of angular momentum, Precession, Gyroscopes, Rolling bodies. Fluid Mechanics: Streamline flow, Bernoulli's theorem and its applications, Airlift and drag.

Simple harmonic Vibrations: Composition of simple harmonic vibration (a) at right angles; (b) in the same straight line, same period, using same amplitude phase diagram

(c) in the same straight line, different periods.

Progressive waves: wave equation in a specific media (e.g., stretched string), transverse and longitudinal waves, beats and Doppler effect.

Elasticity: Elastic Constants, Poisson's Ratio, Bending of a Beam.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Newtonian mechanics: AP French (I, II, III).
2. Physics for Scientists and Engineers, R.A. Serway, 9th Edition, (2013), Elsevier, USA.
3. Fundamentals of Physics, Volumes 1 & 2 (2013), by D. Halliday, R. Resnick, J. Walker, John Wiley & Sons, New York.
4. Physics, Principles with Applications, by D.C. Giancoli, (2014), Addison-Wesley, New York.
5. Waves and Oscillations, N. Subrahmanyam Brij Lal, 2nd Edition (Vikas Publishing).
6. Vibration and Waves in Physics, Iain G. Main, 3rd Edition (Cambridge university press).

Course Title	Physics in Biology and Medicine			Course Code	PHM 11221		
				Prerequest	-		
Level	1	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide students with a knowledge and understanding of physical principles involved in the areas of Biology and Medicine and how to relate them in practical situations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain how forces acting on and in human body during bending, lifting, falling, etc. and demonstrate simple physics models for such activities.
- Quantitatively determine forces acting on and in human body during the processes using these models and suggests some precautions for such activities in day to day life.
- Solve numerical problems based on the models for such activities.
- Describe the source of energy production of the body, thermal equilibrium, conservation of energy, exchange of energy during work done, etc.
- Explain mechanics of the cardiovascular system and of blood flow and pressure by the heart.
- Describe how Physics used for medical diagnostics purposes.
- Demonstrate the functions of some important medical instruments' and diagnostic applications.

Course Content:

Forces on and in the Human Body:

Static and dynamic forces: Bending, Lifting and Falling; Fracture of bones: falling and precautions; Static forces: friction forces and its uses; Dynamic of body: Jumping, Whiplash injury, etc.

Energy, work and power of the body: Conservation of energy in the body; Energy changes in the body; Work and power; Heat losses from the body.

Physics of the Cardiovascular system: The heart and circulatory system; Work done by the heart; Blood pressure and blood flow; Cardiovascular instrumentation.

Physics of diagnostic Techniques: X-rays and its uses in Medicines, Nuclear radiation and its uses in Medicines, Ultrasonic Scanning, Magnetic Resonance Imaging, etc., Laser in medicine, Radiation therapy and radiation protection.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Physics with Illustrative Examples from Medicine and Biology: Statistical Physics by G. B. Benedek, F.M.H. Villars, Springer Science & Business Media (2000).
2. Jean A. Pope, Medical Physics.
3. J.R. Cameron, J.G. Skofronsick, Medical Physics.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">General Physics Laboratory I</td><td>Course Code</td><td colspan="3">PHM 11231</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>05</td></tr>
</table>

Aim of the Course:

This course is aimed to provide opportunity for students to engage in laboratory work in observing and experiencing physical phenomena in General Physics and Physics in Biology and Medicine. The course is expected to provide hands-on experimental skills and interpretation of experimental observations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate the Newton's Laws of Motion and apply them to simple physical systems.
- Demonstrate knowledge of the Law of Conservation of Energy, Conservation of Momentum and apply it to simple mechanical systems.
- Demonstrate knowledge of Rotational dynamics and Fluid mechanics, and apply them to simple physical systems.
- Demonstrate the functions of some important medical instruments and diagnostic applications.

Course Content:

Experiments based on the General Physics (PHM 11212) and Physics in Biology and Medicine (PHM 11221).

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

Laboratory Handouts

Course Title	Physical Optics and Optical Instruments			Course Code	PHM 12212		
				Prerequest	-		
Level	1	Semester	II	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide students with an understanding of basic concepts in interference, diffraction and polarization of light and their applications in optical instruments.
To Familiarize with the resolving power calculations for optical instruments.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define and understand the phenomena of interference, diffraction and polarization of light.
- Explain the experimental observations of interference and diffraction of light, and hence identify the conditions required to observe such wave behavior of light.
- Distinguish the formation of different types of interference and diffraction fringes.
- Apply the established theoretical concepts of wave optics in optical instrumentation, spectroscopy, holography, digital devices and fiber optics.
- Develop problem solving skills on interference and diffraction of light.
- Describe how laser light differs from ordinary light.

Course Content:

Introduction: Nature of light, electromagnetic wave spectrum, Equation of progressive wave.

Interference: Superposition of two sinusoidal waves, conditions necessary to observe interference of light, coherence and incoherence, division of wave-front and division of amplitude to obtain mutually coherent beams for interference.

Two beam interference by division of wave-front: Young's double slit Experiment, Fresnel's biprism, Lloyd's mirror;

two beam interference by division of amplitude: fringes of equal inclination and equal thickness, Michelson Interferometer, Newton's Rings, Wedge films,

Diffraction: Introduction, Fraunhofer and Fresnel diffraction, Huygens' principle, Fraunhofer diffraction by a single and double slit.

Polarization and scattering of light: Polarization by (a) crystal (b) reflection (c) Double reflection (d) scattering (of air molecules, colloidal particles), scattering and the colours in the sky.

Review of Fraunhofer diffraction, Fraunhofer diffraction by circular aperture, multiple

slit diffraction, diffraction grating.

Resolving power of optical instruments: The optical image and diffraction, Rayleigh criterion for resolution of optical image, resolving power optical imaging - human eye, telescope, microscope; chromatic resolving power of prism spectrometer; Multiple beam interference and chromatic resolving power of grating and Fabry-Perot Interferometer. Lasers: principle of lasers, time and space coherence, gas and solid lasers, applications of lasers.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Fundamentals of Optics, Francis A. Jenkins & Harvey E. White, Mc Graw-Hill International Editions.
2. Geometrical and Physical Optics, 3rd Edition, R.S. Longhurst, Orient Longman Publication.
3. A textbook of Optics, N. Subrahmanyam, S.Chand & Company Ltd.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Nanoscience and Nanotechnology</td><td>Course Code</td><td colspan="3">PHM 12221</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

The course aims to provide a basic understanding of nano materials and their fabrication, utilization in various areas including materials science, electronics, medicine and environment.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the properties of nanomaterials.
- Understand the synthetization and applications in materials science, electronics, medicine and environment.

Course Content:

Introduction: Meaning of "nano", Definition of Nanoscience and Nanotechnology, Some Different Size Ranges, Techniques to see different size ranges, Naturally Occurring and Man-Made Structures at different size ranges.

Historical Aspects: Evidences for the use of nanotechnology by ancient people, Nanotimeline and main discoveries in nanotechnology.

Nanotechnology Products and Nano Materials: Pregnancy test, Cancer treatment, Quantum dots, Carbon nanotube-based materials, Odor-free clothing, Microelectronics-advanced circuits, Food products, advantages, special properties and functionalities used in such products, Potential uses of nanomaterials in electronics, robotics, computers, sensors in textiles, sports equipment, mobile electronic devices, vehicles and transportation. Medical applications of nanomaterials, Nanotechnology for a Sustainable Environment.

Special properties and Uniqueness of the Nano-scale: Very small size, High surface to volume ratio, Surface forces dominate over bulk forces, Quantum mechanical effects, Sizes corresponding to basic biological structures, Sizes corresponding to macro-molecules, Unique chemical bonding configurations possible, Size range in which molecules can self-assemble, New epistemologies.

Characterization Techniques: Electron beam-based tools and Scanning probe tools, basic operations of TEM, SEM, FE-SEM, AFM, STM and their capabilities.

Nanofabrication: Top-down, Bottom-up and Hybrid nanofabrications and their important steps and processes, representative examples.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, B. Raj, B.B. Rath, J. Murday, Springer (2013).
2. The Physics and Chemistry of Nanosolids, Frank Owens and C. Poole, John Wiley, 2008.
3. Nano-The essentials, T. Pradeep, McGraw Hill, 2008.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Optical Physics Laboratory</td><td>Course Code</td><td colspan="3">PHM 12231</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>05</td></tr>
</table>

Aim of the Course:

This course is aimed to provide opportunity for students to engage in laboratory work in observing and experiencing phenomena in Physical Optics. The course is expected to provide hands-on experimental skills and interpretation of experimental observations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate diffraction of light by single slit, double slit and grating
- Demonstrate interference of light by interferometers, Newton's ring and air wedge experiments.
- Demonstrate the properties of lasers.

Course Content:

Experiments based on the Physical Optics and Optical Instruments (PHM 12212).

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

Laboratory Handouts

Course Title	Thermal and Statistical Physics			**Course Code**	PHM 21212		
				Prerequest	-		
Level	2	**Semester**	I	**Credits**	02	**Theory (hrs.)**	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

The course aims to provide a basic understanding of thermodynamic systems and the laws of thermodynamics to evaluate various thermodynamic processes used for energy production.
The course also aims to provide a foundation on the statistical approach in analysing physical systems in order to apply the laws of statistical distribution to a wide variety of physical systems.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define and describe different types of thermodynamics processes.
- State and describe thermodynamics laws and explain the function of a heat engine.
- Define entropy and apply various thermals system and conditions.
- Describe kinetic theory of gases.
- Distinguish between microscopic and macroscopic states of thermodynamic systems.
- Derive expressions for variations of microscopic properties of macroscopic thermodynamic systems
- Derive expressions for partition functions in order to derive thermodynamic state functions
- Understand the difference between statistical treatments for classical and quantum systems and hence apply Fermi-Dirac and Bose-Einstein statistics for fermions and bosons respectively.

Course Content:

Thermodynamic systems, State of a system, state variables, equation of state, thermodynamic equilibrium, zeroth law of thermodynamics.

Thermodynamic processes: adiabatic, Reversible and non-reversible, isothermal, isobaric, isochoric; isobaric volume expansively, isothermal compressibility. Fundamental concepts, Equations of states, first law of Thermodynamics, heat, work, internal energy, applications of First Law; Entropy and the Second Law of thermodynamics, Carnot cycle, Combined first and second laws, General thermodynamic functions, Phase transformation, Thermoelectricity; Introduction to Third Law of Thermodynamics. Refrigerators and heat pumps, Thermodynamic cycles, Thermal efficiency of an engine operating in Otto cycle and in Diesel cycle, Power delivered by multi- cylinder gasoline engine and diesel engine, Helmholtz and Gibbs functions, Maxwell's relations with applications.

Introduction of statistical Physics, Energy states and energy levels, macrostates and microstates. Thermodynamic probability, Maxwell-Boltzmann Statistics, Fermi-Dirac

Statistics, Bose-Einstein Statistics, Statistical interpretation of Entropy. Distribution functions and Comparison of them for indistinguishable particles; The Partition function; and some selected topics in statistical physics.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Basic Thermodynamics, By Evelyn Guha, 4th Edition (Narosa Publication)
2. Thermodynamics An Engineering Aproach, By Yunus A. Cengel Michael A.Boles, 4th Edition(McGRAW-HILL International)
3. Statistical Physics (Introductory Course), Daniel J. Amit & Yosef Vebin, World scientific publishing
4. Fundamentals of Statistical and Thermal Physics, F. Reif, McGraw-Hill/ Levant Book Publishers (1967).
5. Introduction to Statistical Physics, Kerson Huang, CRC press, London.
6. Statistical Physics, Kerson Huang, John Wiley & Sons.

Course Title	Energy and Environmental Physics			**Course Code**	PHM 21221		
				Prerequest	-		
Level	2	**Semester**	I	**Credits**	01	**Theory (hrs.)**	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course aims to provide a basic understanding of energy sources and applications. The course also aims to provide an understanding of the environment and the atmosphere and how various physical processes affects the environment, particularly in relation to the production and utilization of different energy sources.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the different types of energy resources.
- Distinguish between the renewable and non-renewable energy sources.
- Describe physical environment.
- Understand the atmospheric compositions and profile and use thermodynamic theories to the atmosphere.

Course Content:

Energy Resources (renewable): Solar energy, Solar radiation and its measurement, Solar thermal devices, Solar cells, Storage of solar energy, Hydropower generation.

Alternative energy sources: Wind energy, Bio gas, Bio mass, Geothermal, Tidal.

Physical environment: Lithosphere, Hydrosphere, Atmosphere, Energy and radiation. The solar system, the Earth's and its rotation, Earth's crust and Geomagnetism. The Hydrosphere, The hydrological cycle, Properties of water. The Atmosphere: Principal layers, troposphere, stratosphere, mesosphere, thermosphere, exosphere, Magnetosphere; The chemical composition of the Earth's atmosphere; the Ideal gas model (the parcel view), exponential variation of pressure with height, Temperature structure and lapse rate. Measuring the water content of the atmosphere, humidity; cloud formation, Growth of water droplets in clouds, Rain and thunderstorms.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Fundamental and Applications of Renewable energy, M. Kanoglu, Y. Cengel, J. Cimbala, 1st edition, Mc Graw Hill.
2. Environment and Pollution, R.S. Ambasht & P.K.Ambasht, 4th Edition(CBS Publishers)
3. The Physics of atmosphere, J.T. Houghton, Cambridge University press.
4. The physical environment, B.K. Ridley, Halsted Press, England & New York.
5. Atmosphere, Waether and climate, Roger G. Barry & Richard J. Chorley, Routledge Publication, London & New York.

Course Title	General Physics Laboratory II			**Course Code**	PHM 21231		
				Prerequest	-		
Level	2	**Semester**	I	**Credits**	01	**Theory (hrs.)**	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

This course is aimed to provide opportunity for students to engage in laboratory work in observing and experiencing the principles in Thermal, statistical and environmental Physics The course is expected to provide hands-on experimental skills and interpretation of experimental observations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate different thermodynamic processes.
- Determine the heat capacities and thermal conductivities of given materials.
- Demonstrate different statistical distributions.

Course Content:

Experiments based on the Thermal and Statistical Physics (PHM 21212) & Energy and Environmental Physics (PHM 21221)

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

Laboratory Handouts

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Solid State Physics</td><td>Course Code</td><td colspan="3">PHM 22211</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

This course aims to provide the student with a basic understanding of crystal structure and types of bonds in solids, difference between metals, insulators and semiconductors in terms of energy band diagrams and the nature of semiconductors.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe basic crystallographic definitions and their uses crystal studies
- Classify solids according to their structures and their electrical, thermal and mechanical properties.
- Understand the band theory of solids and distinguish conductors, insulators and semiconductors.
- Understand the basic theory of Semiconductor Physics.

Course Content:

Crystal structure: Chemical bonding in solids, the crystalline state, crystal symmetry and Bravais lattices, unit cell, basis and crystal structure, packing fraction; Indices of direction, crystal planes and Miller indices, reciprocal lattice.

Crystal diffraction: Bragg's diffraction law, experimental methods in x-ray diffraction – rotating crystal method, Laue method and powder method; outline of electron and neutron diffraction. Material and Structure identification

Metals: Quantum mechanical free electron theory and properties of metals; failure of free electron model and the band theory of solids, conductors, insulators and semiconductors. Thermal conductivity and Electrical conductivity

Semiconductor Physics: The charge carriers, the concept of holes, intrinsic and extrinsic semiconductors, electrical conductivity of a semiconductor, the density of states, carrier concentration and Fermi energy level, Hall effect.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Charles Kittle, Introduction to Solid State Physics, John Wiley & Sons.
2. Blakemore, J.S., Solid State Physics, Cambridge University Press, (2nd ed.).
3. Ashcroft, Neil, W., Mermin, N., David, Solid State Physics, Thomson Brooks.
4. Elementary Solid-State Physics by Ali Omar, Pearson Education India (1999).

Course Title	Electromagnetism			Course Code	PHM 22222		
				Prerequest	-		
Level	2	Semester	II	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

This course aims to provide a basic understanding of the concepts and principles of electromagnetism, and their applications to various practical situations. Students are expected to develop strong problem-solving skills related to a wide range of applications in electromagnetic phenomena.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Clearly describe and apply Coulomb's law and Gauss's law in Electrostatics.
- Obtain a relation between electric potential and electric field, apply it to different charged conductors and use to determine the capacitance of the various shapes of capacitors.
- Solve various numerical problems based on these laws
- Describe various magnetic properties of matters and define magnetic susceptibility, Permeability and hysteresis.
- Clearly explain Electromagnetic laws, Biot-Savart Law, Helmholts coil, Amperes circuital theorem and its applications.
- Solve various numerical problems on Electromagnetic applications.
- Describe electromagnetic induction and define self and mutual inductance.

Course Content:

Electrostatics: Review of basic concepts of electrostatics, Coulomb's Law, Electric flux and Gauss's Law, Potential difference, Equipotential surfaces, Charge distribution on conductors, point discharge, Particle precipitators, Dielectrics, Electric susceptibility, Permittivity. Divergence theorem, Stokes's theorem, Poisson's equation, Laplace's equation, Electric dipole, Polarization.

Magnetism: Origin of dia-, para- and ferro-magnetism, magnetic susceptibility, Permeability and hysteresis, magnetic circuits and recording devices.

Electromagnetics: Biot-Savart Law, Helmholtz coil, Amperes circuital theorem and their applications, Lorenz force, The divergence of B, Magnetic dipole, Laws of electromagnetic induction, Self and mutual inductance.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Grant I S, Phillips W R, Electromagnetism, John Wiley & sons, (7th ed.).
2. Powell, R.G; G.E. Drabble, Electromagnetism, London Macmillan.
3. Electromagnetic Fields and Waves: Including Electric Circuits, by P. Lorrain and F. L. Freeman (1988).

Course Title	General Physics Laboratory III			**Course Code**	PHM 22231		
				Prerequest	-		
Level	2	**Semester**	II	**Credits**	01	**Theory (hrs.)**	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

This course is aimed to provide opportunity for students to engage in laboratory work in observing and experiencing the principles in Solid State Physics and Electromagnetism. The course is expected to provide hands-on experimental skills and interpretation of experimental observations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate the electromagnetic induction
- Demonstrate the laws related to the electromagnetism
- Understand the properties of solid materials.

Course Content:

Experiments based on the Solid State Physics (PHM 22211) & Electromagnetism (PHM 22222)

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

Laboratory Handouts

Course Title	Electronics			**Course Code**	PHM 31212		
				Prerequest	-		
Level	3	**Semester**	I	**Credits**	02	**Theory (hrs.)**	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide a better theoretical understanding of the semiconductor devices and various circuit components used in electronics circuits in order to be able to design analog and digital electronics circuits.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe the operation and function of MOSFET and BJT.
- Analyze and design amplifier electronic circuits using MOSFET and BJT.
- Explain the frequency response of the amplifier
- Describe feedback concept in amplifier circuits and advantages
- Demonstrate knowledge in operational amplifier and its applications
- Make use of the different representations of digital circuits: truth tables, circuit diagrams and logical world descriptions
- Explaining the operation of simple sequential circuits, including flip-flops, counters and registers.

Course Content:

Transistor: Introduction, characteristic and biasing of BJT and FET; BJT amplifier circuits: common base, common emitter and emitter follower; FET amplifier circuits; Transistor as a switch;

Small Signal Analysis: h-parameter model for BJT and analysis of BJT amplifier parameters;

Feedback: Basic idea of feedback, effect of negative feedback on BJT amplifier; Positive feedback and oscillators;

Operational Amplifiers: Significant features and characteristics, Inverting, non-inverting and difference amplifier models, Op-amp based electronic ammeters and voltmeters, analogue computer design: differentiators and integrators, solving differential equations;

Digital Electronics: Digital and analogue method, Number systems, Binary arithmetic in computers, Conversion Algorithms, Law of Boolean algebra, Boolean expressions, Basic Logic Elements, Logic Hardware using diode and transistors, Combinational logic system and circuit design, Sequential logic system and its elements, various types of Flip-Flops, Ripple counters, various memory circuits.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Horowitz and Hill, The Art of Electronics, Cambridge University Press (2nd ed.).
2. William H. Gothman, Digital Electronics, PHI Learning (2nd ed.).

Course Title	Quantum Mechanics			Course Code	PHM 31221		
				Prerequest	-		
Level	3	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course aims to provide an understanding of the historical development and philosophical nature of quantum mechanics.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the concept of blackbody radiation, Photoelectric effect, Compton Effect, Planck's hypothesis, and Einstein's quantum explanation.
- Explain why light can be consider to be small packets of energy
- Describe evidence for the particle nature of light and wave properties of matter
- Understand how to use the wave function and Schroedinger's equation to account for the tunneling of a particle through a barrier.

Course Content:

Birth of Quantum Theory: Failure of classical physics and the birth of quantum Physics: Black body radiation and the Planck's hypothesis of quantization of radiation, the photoelectric effect, Einstein's quantum explanation, Compton effect, the dual nature of electromagnetic radiation. Matter waves and De Broglie's hypothesis, Davission-Germer experiment, the Millikan's oil drop experiment and particle nature of electron, wave-particle duality of matter, the uncertainty principle.

Quantum Mechanics: The Heisenberg's Uncertainty Principle, probability amplitude and wave function, Scrödinger's equation, interpretation of wave function, probability density, expectation value, momentum and energy, time-independent Scrödinger's equation and it's solutions in some simple cases: The free particle, 1-D potential well and energy quantization, 1-D potential step and potential barrier; reflection and transmission coefficients, tunnelling.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Modern Physics, Kenneth Krane, 2nd Edition
2. Fundamentals of Modern Physics, Robert Martin Eisberg
3. Quantum Mechanics, Alastair I.M. Rae
4. Quantum Physics of atoms, molecules, solids, nuclei, and particles, Robert Eisberg & Robert Resnick

Course Title	Electrical and Electronic Laboratory			**Course Code**	PHM 31231		
				Prerequest	-		
Level	3	**Semester**	I	**Credits**	01	**Theory (hrs.)**	-
						Practical (hrs.)	45
						Independent Learning (hrs.)	05

Aim of the Course:

This course is aimed to provide opportunity for students to engage in laboratory work in observing and experiencing the principles in Quantum Mechanics and Electronics. The course is expected to provide hands-on experimental skills and interpretation of experimental observations.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate the characteristics of transistors, diodes and ICs
- Determine the ripple factor of rectifiers.
- Demonstrate the digital electronic functions.
- Demonstrate quantum Physics related experiments

Course Content:

Experiments based on the Electronics (PHM 31212) and Quantum Mechanics (PHM 31221)

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

Laboratory Handouts

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Special Theory of Relativity</td><td>Course Code</td><td colspan="3">PHM 32211</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

This course is aimed at familiarizing with mathematical arguments and the concept of non-absoluteness, and derive transformation equations for physical observables from different inertial frames of reference, in order to realize the relativistic effect caused by high velocities comparable to the velocity of light.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand that simultaneity is relative to the observer.
- Demonstrate that the Lorentz transformations account for time dilation and length contraction.
- Explain how to relate the velocity of a particle in different Lorentz frames.
- Understands how the Lorentz transformation accounts for the ability of muons, created at the top of the atmosphere, are able to penetrate to the surface of the Earth
- Understand and use the relativistic relation between mass, energy and momentum, and its agreement with Newtonian physics at non-relativistic speeds.

Course Content:

Introduction: Review of the Galilean transformation and electromagnetic theory; the Michelson-Morley experiment, Einstein's postulates, the Lorentz Transformation; Simultaneity, time dilation and length contraction and the velocity transformations. Relativistic mechanics, transformation of momentum and energy, relativistic Doppler effect and space-time diagram and experimental verifications of the theory.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Introductory Special Relativity, WGV. Rosser, Taylor & Francis Publication
2. Principles of Modern Physics, Ajay.K. Saxena, Narosa Publishing House
3. Introduction to Special Relativity, by Resnick, Wiley India Pvt. Limited (2007)
4. Special Relativity by A.P. French, 2nd Edition, Chapman & Hill (1990).

Course Title	Atomic and Nuclear Physics			Course Code	PHM 32221		
				Prerequest	-		
Level	3	Semester	II	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course aims to provide an understanding of the nature of the atom and the interaction between the atomic nucleus and electrons.
The course also aims to provide an understanding of the concepts in the nuclear physics and its applications.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Recognize the relation between the magnetic dipole moment of an atom, and its angular momentum quantum number.
- Explain atomic orbital and spin angular momentum, atomic spectra and electron spin.
- Describe the atomic nuclei, binding energy and stability of various nuclei.
- Explain the concept of radioactivity.
- Distinguish between nuclear fission and nuclear fusion.

Course Content:

Atomic Physics: Atomic spectra: Thomson's and Rutherford's model of atom; Bohr theory of hydrogen atom, quantization of momentum and energy, excitation and ionization energies, hydrogen-like atoms, Frank-Hertz experiment, x-rays and their origin X-ray spectra, Moseley's Law. Bhor theory and Rhdberg's formula, spectroscopic notation.

Angular Momentum: Orbital, spin and total; L-S coupling and j-j coupling, selection rules. Effect of external magnetic field: normal and anomalous Zeeman effect, Zeeman pattern of hydrogen and sodium D-lines.

Distribution of Nuclear matter: Rutherford's experiment of α – particle scattering; other experimental evidence for nuclear structure; nuclear density variation; nuclear radius.

Nuclear Binding energy: neutron–proton separation energy; features of binding energy curve; liquid drop model; semi-empirical mass formula; nuclear stability of isobars. Nuclear decay: α-, β- and γ-decay processes and energy release; half-life time and mean life. Nuclear reaction; Nuclear Fission and Fusion; spontaneous and induced fission; energy released in fission; chain reaction; fission reactors. Introduction to particle physics, weak and strong interaction, fundamental particles.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Introductory Nuclear Physics, Kenneth S. Krane, John Wiley & Sons, Inc.
2. Atomic and Nuclear Physics, John Yarwood, University Tutorial Press Ltd.
3. Atomic and Nuclear Physics, N. Subrahmaniyan, S.Chand & Co Ltd.
4. Fundamentals of Modern Physics, Robert Martin Eisberg, John Wiley & Sons. Inc.

Course Title	Astrophysics I			Course Code	PHM 32231		
				Prerequest	-		
Level	3	Semester	II	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

The course aims to provide an understanding of the principles and events related to the Astrophysics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the gravitation law
- Understand the formation of stars and classification of stars.
- Understand the big Bang theory
- Explain the cosmic waves

Course Content:

Theory of Gravitation and its Applications, formation and evolution of stars, Properties and structure of Solar System and Planets, Planets, Stars and the Sun. Star Classifications, H-R diagrams and Main sequence stars, Post-Main-Sequence Stars, Relativity and Black Holes, Galactic Structure, properties and Classification, Cosmology: Hubble Expansion, Big Bang Cosmology, Cosmic Microwave, Cosmological Parameters, Early Universe Physics.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. An Introduction to Modern Astrophysics (2nd Edition), by B.W. Carroll and D.A. Ostlie, Pearson Addison-Wesley, 2007
2. Zeilik, Michael and Gregory, Stephen A., Introductory Astronomy and Astrophysics 4th Ed. (1998), Saunders college publishing, 4thed

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">General Physics Laboratory IV</td><td>Course Code</td><td colspan="3">PHM 32241</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>45</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>05</td></tr>
</table>

Aim of the Course:

The aim of this laboratory course is to develop hand-on and analytical skills of students by performing experiments under the topics of advanced physics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Carry out experiments to demonstrate the advanced Physics.
- Explore the Physics based industries.

Course Content:

Experiments based on the Atomic and Nuclear Physics (PHM 32221) and selected experiments related to the properties of matter.

Mode of Assessment and weightage:

- Continuous Assessment (laboratory Reports) – 50%
- End Semester Examination – 50%

References:

Laboratory Handouts

Auxiliary Courses

Course Title	English Level I			Course Code	ELA 11211		
				Prerequest	-		
Level	1	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

This course aims to provide students with basic integrated language and study skills with extra emphasis on receptive language skills of listening and reading which are essential for success in educational programs conducted in English medium.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Talk about general topics and ask questions
- Develop effective reading skills – skimming and scanning
- Identify specific information in short texts
- Identify and use grammar for general and academic purposes
- Understand the grammatical elements of words
- Develop general and academic vocabulary
- Listen and understand the lecture to find out the main points and make notes
- Improve writing skills at sentence and paragraph level

Course Content:

Our Neighborhood: Brief introductions (greeting and reply appropriately, simple conversations, asking questions), Reading related to neighborhood**,** Grammar (full verb, primary verb, simple present and past)**,** Vocabulary based on the topic**,** Compose a few sentences about the neighborhood using there is/ there are, Listen to an announcement and fill in the blanks.

Earth: Inside and Out, Reading related to Earth, Grammar (present continuous and future forms), Vocabulary: analyze words to find meanings – prefixes, Write a short paragraph on earth, Listen to a short speech on earth and take down simple notes
Give a brief introduction on earth.

Environment: Reading base on environment, Grammar (past continuous and adverbs of frequency), Vocabulary based on the topic, Write sentences using adverbs of frequency Listen to a short speech and fill in the mind map, Ask questions and give answers using the mind map.

Water: Reading based on water, Grammar (kinds of nouns: common/ proper/ abstract/ pluralization of nouns/ count nouns/non-count nouns), Vocabulary: suffixes, Listen to a lecture on water and take down notes, Discuss the poem 'Water, Water Everywhere…' Writing – Describe the water cycle with a diagram.

Mode of Assessment and Weightage:

- End Semester Examination – 100%

References:

1. Student' Manual for ELA 11211 designed by AHEAD projects.
2. Murphy, Raymond (2005) Essential English Grammar. Cambridge: Cambridge University Press.
3. Wallace, Michael J. (1998). Study Skills in English. Cambridge: Cambridge University

Course Title	English Level II			Course Code	ELA 12211		
				Prerequest	-		
Level	1	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

This course aims to provide students with basic integrated language and study skills with extra emphasis on receptive language skills of listening and reading which are essential for success in educational programs conducted in English medium.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Talk about general topics and ask questions
- Develop effective reading skills – skimming and scanning
- Identify specific information in short texts
- Identify and use grammar for general and academic purposes
- Understand the grammatical elements of words
- Develop general and academic vocabulary
- Listen and understand the lecture to find out the main points and make notes
- Improve writing skills at sentence and paragraph level

Course Content:

Weather: Reading related to weather, Grammar (some basic uses of prepositions denoting time and date, travel and movement, usual position of prepositions), Vocabulary based on the topic, Listen to a weather forecast and fill in the blanks, Talk about day weather using "Wh" questions, Write a weather forecast.

Climate Change: Reading related to climate change, Grammar (articles and use-omission of indefinite/ definite article), Vocabulary related to describing line graphs, Write a paragraph describing a line graph, Listen to a speech on climate change and take down notes, Describe a line graph.

Environmental Pollution: Reading based on environmental pollution , Grammar (use of determiners: little/a little, few/ a few, all, each, both, some, etc.) , Vocabulary based on the topic and describing pie charts, Describe a pie chart, Listen to a discussion on environmental pollution and take down notes, Group discussion on how to prevent environmental pollution.

Waste Management: Reading base on waste management, Grammar (modal verbs), Vocabulary base on the topic and describing tables, Listen to a lecture on waste management fill in a mind map, Discuss the important of waste management, Write a list of simple instructions to follow "How to manage waste in homes".

Mode of Assessment and Weightage:

- End Semester Examination – 100%

References:

1. Student' Manual for ELA 11211 designed by AHEAD projects
2. Murphy, Raymond (2005) Essential English Grammar. Cambridge: Cambridge University Press
3. Wallace,Michael J. (1998). Study Skills in English. Cambridge: Cambridge University

Course Title	English Level III			Course Code	ELA 21211		
				Prerequest	-		
Level	2	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

This course aims to offer students with integrated language and study skills important for success in educational programs conducted in English medium.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Talk about academic topics
- Develop advanced reading skills
- Identify specific information in texts identify and use grammar for general and academic purposes
- Understand the grammatical elements of words
- Develop general and academic vocabulary
- Listen and understand the lecture to find out the main points and supporting details
- Improve writing skills in the paragraph level

Course Content:

Electricity: Reading related to electricity, Grammar (basis conjunctions), Vocabulary base on the topic and more academic vocabulary, Compose sentence and small paragraphs, Listen to lecturer on electricity and take down notes, Discuss the use of electricity at home.

Inventions: Reading related to inventions, Grammar (basic kind of adjectives: demonstrative, distributive, quantitative, interrogative possessive and of quality), Vocabulary: analyze words to find meanings using prefixes, Find the facts about a famous inventor and write a small essay, Present the famous inventor to the class, Listen to a speech and take down notes.

Solar Power: Reading base on solar power, Grammar (position of adjectives: attributive/ predicative and comparison of adjectives), Academic vocabulary, Listen to a speech and fill in the mind map, Write a paragraph on solar power, Discuss the advantages and disadvantages of using solar power.

Cloning: Reading base on the topic, Grammar (kinds of adverb: manner, place, time, frequency etc.), Vocabulary related to the topic and academic words, Listen to a lecturer on cloning and take down notes, Discuss the negative issues of cloning, Writing three paragraph positive and negative issues of cloning.

Mode of Assessment and Weightage:

- End Semester Examination – 100%

References:

1. Student's Manual for ELA 21211 designed by AHEAD project
2. Murphy, Raymond (2005) Essential English Grammar. Cambridge: Cambridge University Press
3. Wallace, Michael J. (1998). Study Skills in English. Cambridge: Cambridge University Press
4. Armer, Tamzen. (2011) Cambridge English for Scientists. Cambridge: Cambridge University Press
5. Michael McCarthy, Felicity O'Dell (2016) Academic Vocabulary in Use. Cambridge: Cambridge University Press

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">English Level IV</td><td>Course Code</td><td colspan="3">ELA 22211</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

This course aims to offer students with integrated language and study skills important for success in educational programs conducted in English medium.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Talk about academic topics
- Develop advanced reading skills
- Identify specific information in texts
- Identify and use grammar for general and academic purposes and understand the grammatical elements of words
- Develop general and academic vocabulary
- Listen and understand the lecture to find out the main points and supporting details
- Improve writing skills at the paragraph level develop presentation skills

Course Content:

Social Networking: Reading related to social networking, Grammar (formation/comparison/ position of adverbs), Vocabulary based on the topic and more academic vocabulary, Listen to a lecture on Wi-Fi and take down notes, Compose sentences and small paragraphs, Discuss the good and the bad sides of social networking using Wh-questions.

Nomophobia: Reading related to the topic, Grammar (active and passive voice), Vocabulary: analyze words to find meanings, Listen to a lecture on Wi-Fi and take down notes, Using the notes write about nomophobia, Discuss and find more words ending with phobia, and present them to the class.

Space Exploration: Reading based on space exploration, Grammar (punctuation) Academic vocabulary, Listen to a speech and fill in a table, Write a paragraph on space exploration, A group presentation on space exploration

Artificial Intelligence: Reading base on the topic, Grammar (numerals and punctuation), Vocabulary related to the topic and academic words, Listen to a lecture on artificial intelligence and take down notes, Discuss the positive and negative issues of artificial intelligence, Design a poster on artificial intelligence and present it to the class.

Mode of Assessment and Weightage:

- End Semester Examination – 100%

References:

1. Student's Manual for ELA 22211 designed by AHEAD project
2. Murphy, Raymond (2005) Essential English Grammar. Cambridge: Cambridge University Press
3. Wallace, Michael J. (1998). Study Skills in English. Cambridge: Cambridge University Press

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Social Harmony</td><td>Course Code</td><td colspan="3">SHA 22221</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
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Aim of the Course:

To provide comprehensive knowledge of social harmony and provide opportunity to learn to live together in peace and harmony

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define the conceptual ideas of social harmony
- Understand and identify the factors contributing to social harmony.
- Apply the knowledge gained to live in peace and harmony.

Course Content:

Introduction to Social Harmony: Definition of social Harmony, Importance, Scope & Nature of social Harmony, Theories of Social Harmony, Approaches to Social Harmony.

Elements that create Social Disharmony: Conflicts, Violence, Substance Abuse, Gender Inequality, Discrimination, Ethnicity, Culture & Society, Religious Conservatism & Fanaticism, Economic inequality.

Historical background to the promotion of Social Harmony: Institutional Level, Individual Level.

Role of World Religions in the Promotion of Social Harmony, Education on Human Values., Field study

Mode of Assessment and weightage:

- Continuous Assessment (field study/stage program)
- End Semester Examination – 100%

References:

1. Hans Kung, (1985). Christianity and the World Religions, Paths to Dialogue with Islam, Hinduism, and Buddhism, Doubleday, Yew York.
2. K.L.SeshagiriRao, (1990). Mahatma Gandhi and Comparative Religion, Motilal Barnasidass Publishers, Delhi.

Course Title	Career Development			Course Code	CDA 31211		
				Prerequest	-		
Level	3	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To know the importance of career development and develop their own future career plan and management systematically.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain importance of career development and define common terms used in career development
- Know the relationship between career development to lifelong learning
- Elaborate career management skills and the role of career information and form of personal support.
- Investigate their career option and do personal SWOT.
- Make awareness of career development resources, select the organization, and review and update their career goal.
- Describe several techniques to enhance opportunities for career development in details.
- Effectively prepare CV and Cover letter for jobs.
- Face Jobs interview successfully.

Course Content:

Introduction: Importance of career development (CD), definition of career management, career development, career goals, career path, etc., lifelong learning, career management skills and the role of career information and form of personal support, challenges in career development, Personal organization and life managements

Charting a Career Path: Investigation of career options, doing personal SWOT, exploring career development resources, selecting organizations, and reviewing and updating career goals.

Techniques to Enhance Opportunities for CD: Networking, Volunteering, Mentoring, Professional associations, Doing research/opportunity scans/researching companies, Participation in task forces and special projects, Finding internship, Education, Career fairs and international opportunities.

Job Search Strategies: Applying basic marketing principles to job search, Marketing Plan for the job, Determination of Target Market, Development of Marketing Tools, Identification of Opportunities & Contacts, Refinement of Presentation Skills, Designing Action Plan.

Applying Job and facing Interview: Preparation of CV and Cover letter for Job, Guidelines for facing job interview.

Mode of Assessment and weightage:

- Continuous Assessment (field study/stage program)
- End Semester Examination – 100%

References:

1. Human Resource Management: A General Manager's Perspective: Text and Cases - Michael Beer, Richard E. Walton, Bert Spector, Paul R. Lawrence, D. Quinn Mills.
2. Career Development: A human resource development perspective- Kimberly McDonald, Linda Hite.
3. Career Development: Concepts and Strategies- Kitty Smith.

Compulsory Courses

Course Title	Biology for Physical Sciences I			Course Code	BLC 11211		
				Prerequest	-		
Level	1	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	-
						Independent Learning (hr)	35

Aim of the Course:

To provide students with the opportunity to acquire the basic knowledge on Biology

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define the basic terminology in biology
- Able to describe the causative agents, symptoms and control measures of diseases.
- Able to describe the structure and function macro compounds of food and nutrition.
- Able to know the composition of blood , structure and function of the organ system
- Understand and importance of tissue culture, DNA finger printing and cloning.
- Compare the significance of contraceptive methods.
- Understand the basics concepts in developmental ecology
- Able to know the basics in heredity.

Course Content:

The characteristic features of life; Infectious diseases and prevention; Food and nutrition; Organ system; Blood cells; Contraceptive methods; Test tube babies; Tissue culture; DNA finger printing; Cloning; Basics in heredity, Basics in Developmental Biology.

Mode of Assessment and Weightage:

- Continuous Assessment (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

References:

1. Samantha Fowler, Rebecca Roush, James Wise o (2013 Principles of Biology – An Introduction to Biological Concepts.
2. Raven et al., (2021 Biology 12th edition,

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Mathematics for Biological Sciences I</td><td>Course Code</td><td colspan="3">MTC 11221</td></tr>
<tr><td>Prerequest</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To equip students with basic calculus needed in biological science

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Find the limits of some real valued functions
- Evaluate derivatives and integrals for selected elementary functions.
- Apply derivatives and integrations to solve physical and geometrical problems.

Course Content:

Differentiation: Derivatives, Rules for differentiation, Differentiation of Exponential, Logarithmic and Trigonometric function, Higher order derivative, Chain rule, Application of differentiation in simple problems (rate of change, extreme values, Curve sketching.

Integration: Definite integral, Indefinite integral, Substitution method, Integration of rational functions and trigonometric functions, Integration by parts, Areas and volumes bounded by curves and some other simple applications.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Examination – 70%

References:

1. **A. A. Klaf, Calculus Refresher, Dover Publication, Inc., 1956.**
2. Elliot Mendelson, Calculs: Schaum's Solved Problem Series, Elliot Mendelson, Tata McGraw-Hill, 2004

Course Title	Biology for Physical Sciences II			Course Code	BLC 12211		
				Prerequest	---		
Level	1	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To provide students with the opportunity to acquire the basic knowledge on Biology.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define Environment and its importance;
- Know different types of organisms
- Identify biotic and abiotic components and its relationship;
- Compare different geochemical cycles.
- Understand the importance of natural resources, depletion and conservative
- Understand the concepts of sustainable development and how to archive global sustainability

Course Content:

Bio diversity: Plant diversity and Animal diversity; Basic principles of evolution, Non-infectious diseases, Basic principles in ecology; Ecosystem and functions, Energy transfer, Carbon, nitrogen, Phosphorus and water cycle; Natural Resources, importance, resource depletion and its impacts; Environmental pollution: pollutants, sources, control; restoration of eco systems, Sustainable development and Global sustainability

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Examination – 70%

References:

1. Raven et al., (2021 Biology 12th edtion,
2. Micheal Allaby, Basic Environmental Science, Tylor and Francis group Limited, 2002;
3. Reeta Khosla, and Zahid H. Siddiqui, Basic Environmental Science, Alpha Science International, Limited, (ISBN 178332287X, 9781783322879), 2017;
4. Kimon Hadjibiros, Ecology and Applied Environmental Science Tylor and Francis group Limited, 2010

Course Title	Mathematics for Biological Sciences II			Course Code	MTC 12221		
				Prerequest	---		
Level	1	Semester	II	Credits	1	Theory (hr)	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To introduce the applications of matrices and vectors in the ordered tuple form for biological science students.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate knowledge of matrices including classification of special matrices
- Perform matrix and vector operations
- Apply the acquired theoretical knowledge in problem solving.

Course Content:

Matrix Algebra: Introduction to Matrices, Types of matrices, Matrix operations, Determinants, Inverse of a matrix, Solution of system of linear equations: using inverse of the matrix, by use of Cramer's rule;
Vector Algebra: Introduction to vectors as n-tuple, vector operations: vector addition, scalar multiplication, dot product, cross product,
vector Calculus: vector differentiation, gradient, divergent and curl in Cartesian coordinate system, Physical and Geometrical interpretations

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Jagdish C. Arya and Robin W. Lardner, Mathematics for the Biological Sciences, Prentice-Hall, 1979.
2. Devi Prasad, Elementary Linear Algebra, Narosa Publishig House, New Delhi, 2012.
3. Shanti Narayan and Mittal P.K.,A Textbook of Vector analysis, S. Chand & Company Ltd, 2007

Elective Courses

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Computational Mathematics - I</td><td>Course Code</td><td colspan="3">CME 11211</td></tr>
<tr><td>Prerequest</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To study numerical techniques using computer programming codes.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain existing computer codes in problem solving numerically
- Find the numerical solutions by using the algorithms
- Interpret the results obtained.

Course Content:

Introduction to Computational Mathematics.
Root finding: Introduction, Algorithms for bisection method and Newton's method.
Interpolation: Polynomial interpolation – Lagrange's form.
System of Linear Equations: Creating matrices using *for* loop, computer codes for matrix addition and scalar multiplication, Algorithm for Gaussian elimination method.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Ward Cheney and David Kincaid, Numerical Mathematics and Computing, Fifth edition, Thomson Learning, 2007
2. Richard L. Burden, J. Douglas Faires, and Annette M. Burden, *Numerical Analysis*, 10th Edition, CENGAGE Learning, 2006.
3. S. Kanaganathan, Fundamentals of Numerical Computing, Kumaran Book House, 2009

Course Title	Leadership and Team Work			Course Code	LTE 11221		
				Prerequest	---		
Level	1	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To develop and strengthen interpersonal leadership and teamwork skills.
To allow students to think more flexibly when solving unexpected problems and to help them reach results on personal and professional levels.
To learn how to perform well during teamwork and how to understand the specific role of leadership in these tasks.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the concept of leadership in the early years
- Demonstrate an awareness of factors that influence leadership and teamwork
- Understand how teamwork can support leadership skills
- Reflect on personal leadership and teamwork skills.

Course Content:

Introduction to team and team works, Characteristics of team members, Team creation and team values. Meetings, Team works Introduction to leaderships, Role of leaders Leadership theories, Leadership styles Characteristics of good leaderships Introduction to problem solving
Steps of problem solving World leaders:
Lord Buddah, Prophet Muhamed Jesus Christ, Mohandas Gandhi Nelson Mandela, Adolf Hilter, Mao Zedong, Joseph Stalin
Individual or group presentations on LTE Watch and analyze the "Team work can make dream work" short film

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Barker, R. (2002). On the nature of leadership. New York, NY: University Press of America.
2. Bass, B. M. & Stogdill, R.M. (1990). Bass & Stogdill's Handbook of Leadership: theory, research, and managerial applications (3rd edn.). New York, NY: Free Press.
3. Buchanan, D. & Huczynski, A. (1997). Organizational Behavior: An introductory text (3rd edn.). London, UK: Prentice-Hall.
4. Ciulla, J. (2004). Ethics, the heart of leadership (2nd edn.). Westport, CT: Praeger.
5. Gardner, H. (1995). Leading minds: An anatomy of leadership. New York, NY: Basic Books.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Stress Management</td><td>Course Code</td><td colspan="3">SME 11231</td></tr>
<tr><td>Prerequest</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

This Stress management course module is designed for university students. This module will help the university students to develop their ability to cope with stress. This module is designed to help university students to have better awareness and understanding of stress and the ways to manages them effectively.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand about stress and the causes of stress
- Help the students to become aware about signs and symptoms of stress
- Understand the outcome of stress and their own optimal levels of stress
- Understand the relationship between arousal and performance
- Help the students to understand the types of stress and aware about Stress Response Cycle
- Help the students to learn about the anatomy and physiology of human body in relation to stress response
- Help the students to learn about Stress related Medical and Mental disorders

Course Content:

Introduction to stress, Good Stress And Bad stress, Yorkes - Dodson Law, Freeze, Fight and Flight response.

Type of stresses: Eustress and Distress, Acute Stress and Chronic Stress, Hyper Stress and Hypo Stress. Anatomy and physiology of human body: Psychophysiology of stress, Autonomic Nervous system responses for stress, Hormonal responses for stress, Stress related medical diseases, Stress related mental disorders.

Managing the stresses: Methods to identify our own stresses, Various methods of managing stress.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Barrett, K., Barman, S., Brooks, H., Yuan, J. and Ganong, W., 2019. Ganong's review of medical physiology. New York: McGraw Hill Education.
2. Ellis, H., Mahadevan, V. and Singh, V., 2015. Ellis' clinical anatomy for medical students. [New Delhi]: Wiley India Pvt. Ltd.
3. Gelder, M., López-Ibor Aliño, J. and Andreasen, N., 2004. New Oxford textbook of psychiatry. Oxford: Oxford University Press.
4. Sinnatamby, C., 2006. Last's Anatomy. Harlow: Churchill Livingstone.

Course Title	Statistics for Sciences			Course Code	SSE 11242		
				Prerequest	-		
Level	1	Semester	I	Credits	2	Theory (hrs.)	25
						Practical (hrs.)	5
						Independent Learning (hrs.)	70

Aim of the Course:

The primary goal of the course is to help students understand how the process of posing a question, collecting data relevant to that question, analyzing data, and interpreting data can help them find answers to real problems from their world.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate the importance of statistics in making decisions on day-to-day life problems
- Design an experiment and generate the probability distribution corresponding to a given real-life situation involving one variable.
- Construct appropriate statistical models for real-life situations and apply concepts and procedures in statistical decision making to those models

Course Contents:

The Nature of Probability and Statistics*:* Descriptive and Inferential Statistics, Variables and Types of Data, Data Collection and Sampling Techniques, Frequency Distributions and Graphs*:* Organizing Data, Histogram, Frequency Polygon, and Ogive, Other Types of Graphs, Data Description*:* Measures of Central, Measures of Variation, Measures of Position, Exploratory Data Analysis, Probability and Counting Rules*:* Sample Spaces and Probability, The Addition Rules for Probability, The Addition Rules for Probability, The Multiplication Rules and Conditional Probability, Counting Rules, Probability Distributions*:* Mean, Variance, Standard Deviation, and Expectation, The Binomial Distribution, Normal Distributions*:* Applications of the Normal Distribution, The Central Limit Theorem, Applications of the Normal Distribution, Confidence Intervals and Sample Size*:* Confidence Intervals for the Mean *w*hen *sigma* Unknown, Difference between two means, Confidence Intervals for the Mean *w*hen s*igma* Known, Difference between two means, Difference between two variances, Correlation and Regression*:* Scatter Plots and Correlation, Regression, Coefficient of Determination and Standard Error of the Estimate.

Mode of Assessment and weightage:

- Continuous Assessments (Quizzes, Assignments, Mid Term) – 30%
- End Semester Examination – 70%

Recommended Texts:

1. Allan G. Bluman, (2013). Elementary Statistics: A Step-by-Step Approach, 9th Edition. Mcgraw Hill Inc.
2. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000). Probability and Statistics, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.
3. Mann, P. S. (2007). Introductory Statistics. John Wiley & Sons.
4. MINITAB Manual

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Information Technology</td><td>Course Code</td><td colspan="3">ITE 12212</td></tr>
<tr><td>Prerequisite</td><td colspan="3">--</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">2</td><td>Theory (hrs.)</td><td>20</td></tr>
<tr><td>Practical (hrs.)</td><td>10</td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

To provide students with the knowledge of computer system, software, hardware, while handling applications using MS Excel, Access and Python programming.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand computer systems fundamentals with data representation and logic gates.
- Differentiate hardware components, software components, operation systems, system software.
- Demonstrate advanced excel formula.
- Understand DBMS concept and create tables using MS Access.
- Write Python code for basic read write operations and file handing.

Course Content:

Introduction to Computer Systems (Theory): Computer system fundamentals, Hardware elements of modern computer systems, Data representation in computer Systems, Basic logic gates & binary number system (NOT, AND, OR, XOR, NAND and NOR)

Windows Operating System Fundamentals (Practical): Operating system configurations, Installing and upgrading client systems, Manage applications, services and disks, Manage devices, Understand file and print sharing, Maintaining & Updating Windows OS

PC Applications (Theory + Practical): Advanced concept in EXCEL (Formulas, Advanced conditional formatting, Pivot tables and reporting, VLOOKUP, INDEX MATCH, Database management using Access.

Database Management System (Theory): Data, Relation, ER Diagram, Primary key and foreign key concept

Python for data handling (Practical): Introduction to python for data handling (datatype, variable and basic functions) File handling: Open a file, reading data from a file and write to a file.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments and Practical Assignments) – 30%
- End Semester Examination – 70%

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Principles of Economics</td><td>Course Code</td><td colspan="3">PEE 12222</td></tr>
<tr><td>Prerequest</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">1</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hr)</td><td>30</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

To understand fundamental concept and practices of economics
To familiarise students with scarce economics resources which form the basis for rational decision by households and firms
To stimulate student's knowledge of decision making within the households and firm
To show the circular relationship between households and firm, input and output and flow of resources within the economy system
To expose the students to economic history and behaviours of households and firms in allocation of resource and in manipulation of factors of production for profit maximisation

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Define economics, state its important and enunciate on assumptions upon which the definitions are based
- State why and how available choices leads to decision making and Relate basic economic concept and problems
- Enumerate the importance of basic economics question and know how to apply rationality to answering the questions in the decision making process
- List and explain different methods of solving economic problem which lead to different types of economies. Differentiate between different types of economies and know the weaknesses and strength of each method of economy
- Explain how firms transforms resources allocated (input) into product (output) and understand the circular flow of supply and demand between households and firm
- Discuss price mechanism, explain demand for a commodity in relation to changes in price and elucidate on factors that determines quantity demanded and supplied. Define elasticity in relation to demand and supply

Course Content:

Economics and basic economics problems; the methodology of economics science; and the general principles of resource allocation; market mechanism-demand and supply; price determination and elasticity, theory of consumer behaviour; theory of production; market structure price and output under perfect competition; monopoly; monopolistic competition and oligopoly. It takes you through the meaning of economics and its various definitions. Since economics is defined based on the two assumptions, the assumptions were elaborated on in relation with some other concepts that are interwoven. Thereby interdependency and complexity of economics become obvious through real life scenario given in the units.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments and Practical Assignments) – 30%
- End Semester Examination – 70%

References:

1. Gregory Mankiw, "Principles of Economics", 8th Edition, Cengage Learning, 2016. ISBN-13: 978-0357038314.
2. Niall Kishtainy, "The Economics Book: Big Ideas Simply Explained", 1st Edition, DK Publishers, 2012. ISBN-13: 978-0756698270.
3. Quentin Batista, Thomas Sargent and Jesse Perla, "QuantEcon DataScience: Introduction to Economic Modeling and Data Science", Center for Innovative Data in Economics, Vancouver School of Economics, UBC, 2020.
4. Steven A. Greenlaw, David Shapiro, "Principles of Economics", 2nd Edition, Rice University - OpenStax, 2020. ISBN-13: 978-1947172371 (Available under CC-BY license at https://openstax.org/details/books/principles-economics-2e)
5. Yves Hilpisch, "Python for Finance: Mastering Data-Driven Finance", 2nd Edition, O'Reilly Media, 2018 ISBN-13: 978-1492024330.

Course Title	Human Resource Management			Course Code	HRE 21212		
				Prerequest	---		
Level	2	Semester	I	Credits	02	Theory (hr)	25
						Practical (hr)	05
						Independent Learning (hr)	70

Aim of the Course:

The overall objective of the programme is to indicate and explain various human resource management interventions that may be required when dealing with the work environment, people, and problems.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the implications of globalization to Human Resource Management, such as technology changes, workforce diversity, changing skill requirements, continuous improvement initiatives, and employee's involvement.
- Be able to deal with the challenges effectively and efficiently in relations to human resources in organizations.
- Have an understanding of importance of human resources in the organization and making fair decisions about their employees.

Course Content:

Human Resource Management- An Overview, HRM and the effects of environmental changes on organizational culture and structure, Human Resource Planning, The effect of technological changes on quality and quantity of manpower needs, Recruitment, Selection, Training and Development, Performance Evaluation, Compensation and Benefits and Development of the quality of HR.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Opatha. H.H.D.N.P. (2009), Human Resource Management. Author Publication.
2. Aquinas. P.G. (2006). Human Resource Management, Principles and Practice, 1st ed.. Vikus Publishing House Pvt Ltd, New Delhi.
3. Aswathappa (2003). Human Resource and Personnel Management, 5th ed., Tata McGraw-Hill puhishing Co.. India.
4. Dessler. G. (1997), Human Resource Management. "' I'd. Prentice Hall of India Private Etd, New Delhi.
5. Milkovich, G.T. & Boudreau ,J.W. (2004). Personnel/ Human Resource Management, 5th ed., Richard D. Irwin, INC. U.S.A.

Course Title	Information Literacy			Course Code	ILE 21222		
				Prerequest	---		
Level	2	Semester	I	Credits	02	Theory (hr)	20
						Practical (hr)	10
						Independent Learning (hr)	70

Aim of the Course:

To provide students with the basic concepts in Knowledge and skills on information Literacy.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify advanced information resources within and outside the library and acquire the skills to search, retrieve and manage information.
- Use scholarly databases and their application in the academic environment.
- Develop independent, lifelong learning and research skills through effective use of information sources.
- Develop application and use of information ethically, by writing assignment /report/ review/article by avoiding plagiarism and proper citation and referencing.

Course Content:

Basic Concept of Information Literacy, Information Skills, Print & E books, Scholarly database, Library Management System, organizing knowledge, Open Educational resources, learning models, academic reading, note taking and writing assignment, abstract, literature reviews, articles, academic integrity, citing and referencing.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Ercegovac, Zorana (2008), Information literacy: Search strategies, tools & resources for high school students and college freshmen, 2nd ed., by, Linworth books, Columbus.
2. Davis-Kahl, Stephanie & Merinda Kaye Hensley [Eds](2013):Common ground at the nexus of information literacy and scholarly communication, American Library Association, Chicago.
3. Lanning, Scott (2012), Concise Guide to Information Literacy, Libraries Unlimited,

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Thousand Point Scheme</td><td>Course Code</td><td colspan="3">TPE 21231</td></tr>
<tr><td>Prerequest</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">I</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td rowspan="3">Independent skill enhancement program</td></tr>
<tr><td>Practical (hr)</td></tr>
<tr><td>Independent Learning (hr)</td></tr>
</table>

Aim of the Course:

The main objective of the thousand-point scheme is to produce responsible and quality graduates with enhanced employability by promoting the variety of extracurricular activities among science undergraduate students. In addition, it is expected to encourage and direct science undergraduate students towards sustainable career goals.

Intended Learning Outcomes:

Specific course learning outcomes (CLOs) cannot be proposed for this course. Different Students will engage in different types of extracurricular activities, which ultimately develop different types of skills among students.

Course Content:

The students, who have completed the 2nd semester of their degree program can apply and register for the course upon their desire during the period of subject registration for the first semester of the second year. However, a particular student will be aware of the course and he/she can start working towards earning points from the first year. They will be educated about the course registration, opportunities for different extracurricular activities at FAS, SEUSL, evaluation criterion, and other relevant information during the subject orientation of the fresh students. First-year onwards, the registered students will be guided in collecting, maintaining, and preparing the relevant documents to earn a better score. The evaluation will be carried out throughout the degree program and based on the pre-defined marking scheme. The course of the 1000 Points Scheme reflects the student's extracurricular performance in knowledge, skills, sense of social responsibility to the community, and other activities that the student may have participated in or contributed to during the time spent at the FAS. A student may earn a maximum of 1000 Points during the entire stay at the FAS from activities other than those related to the curriculum of the degree program. The effort that the students put in accumulating the points will help them in achieving the graduate attributes that are needed for employability. A separate system namely Student Information System (SIS) will be established at the FAS to monitor and record the progress of the course continuously. The course is coordinated by the Department of Physical Sciences, FAS, SEUSL. All the details related to this course can be found in the 'Guidelines for Thousand point scheme' issued by the Department of Physical Sciences.

Mode of Assessment and weightage:

The evaluation will be carried out throughout the degree program based on the pre-defined marking scheme. All the essential details can be found in the 'Guidelines for Thousand point scheme' issued by the Department of Physical Sciences.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Web Application Development</td><td>Course Code</td><td colspan="3">WAE 21241</td></tr>
<tr><td>Prerequisite</td><td colspan="3">--</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">1</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>10</td></tr>
<tr><td>Practical (hr)</td><td>05</td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

To provide students with the knowledge of web application development techniques.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand basics of website implementation and integration.
- Write client-side web interfaces using HTML and Java Scripts.
- Familiarize with Word Press.

Course Content:

Web Interfaces using HTML and scripting languages, Basics of website implementation and integration, Content management systems, Web design using WordPress, Web development-Mini project

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, practical Assignments and Mini projects) – 30%
- End Semester Examination – 70%

Course Title	Basic Climatology			Course Code	BCE 21252		
				Prerequest	-		
Level	2	Semester	I	Credits		Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To produce science graduates who are equipped with basic climatological knowledge and skills to understand climatic processes and the evolution of natural systems.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Explain the interaction between the atmosphere and hydrosphere in relation to the climate
- Discuss the change of climate with changing the climatic elements
- Explain the driving processes of world climate and how a change in the influence of these processes could affect the world climate
- Distinguish between the different world climatic zones
- Explain the factors influencing the weather and climate of Sri Lanka
- Interpret the interaction of anthropogenic activities with climatic processes and consequences of the greenhouse effect.

Course Content:

Introduction to climatology (basic climatological concepts, physical and chemical features of the atmosphere, climatic elements); Climatic processes and controls; World's climate; Koppens climate classification system; Sri Lankan climate and climate controls; Applied Climatology (Weather measurement, greenhouse effect & global warming).

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Thompson, R.D., and Perry, A. (1997): Applied Climatology: Principles and Practice, 1st edition, London: Routledge, 388 pp.
2. Rohli, R. V., & Vega, A. J. (2017). Climatology. Jones & Bartlett Learning

Course Title	Computational Mathematics - II			Course Code	CME 21261		
				Prerequest	---		
Level	2	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To provide skills in solving system of linear equations and initial value problems through the use of established techniques.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Develop and use algorithms to find solution of system of linear equations
- Find approximate solutions to initial value problems using numerical methods
- Estimate the error bound

Course Content:

System of linear equations: LU decomposition, LU decomposition with pivoting, using LU decomposition to solve SLEs.
Numerical methods for solving initial value problems (IVPs): Euler's methods, improved Euler method, error analysis, Runge-Kutta methods.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. R. Gupta, *Golden Maths Series Numerical Analysis*, Laxmi publications (p) ltd, 2011
2. Curtis F. Gerald and Patrick O. Wheatley, *Applied Numerical Analysis*, Pearson Education, Inc. 2004.

Course Title	Medical Laboratory Techniques			Course Code	MLE 22212		
				Prerequest	-		
Level	2	Semester	II	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To provide basic concepts relating to different laboratory investigations and overview of functions of a diagnostic laboratory

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Analyze the application of management principles in a medical laboratory
- Explain the precautions and laboratory safety measures which need to be practiced while working in the laboratory
- Provide first aid in an emergency situation
- Explain the basic principles and application of analytical equipment used in the medical laboratory
- Describe the collection strategies for different clinical samples and specifications for suitable containers for sample collection and transport
- Explain the routine investigations in a medical laboratory and their significance in diagnosis of diseases
- Describe the steps and importance of medical laboratory quality assurance and accreditation

Course Content:

Laboratory Organization and Management, Laboratory Safety, Laboratory equipment and basic laboratory operations, General aspects of sample collection, transportation and storage, Medical Microbiology, Clinical Chemistry, Hematology, Diagnostic Parasitology, Clinical Immunology, Molecular Diagnostics, Medical Laboratory Quality Assurance & Accreditation.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

- Brooks, G.F., Butel, J.S. and Morse S.A. (2004). Jawetz, Melnick and Adelberg's Medical Microbiology. 3rd Edition or more advanced Ed, McGraw Hill Press.
- Mims, C., Dockrell, H.M., Goering, R.V., Roitt, I., Wakelin, D. and Zukerman, M. (2005). Medical Microbiology, 3rd Edition, Elsevier Mosby Publishers.
- Cheesebrough, M. (1998). District laboratory practice in tropical countries (Part 1 & 2), Cambridge University press, UK.
- Barrow, G., & Feltham, R. (Eds.). (1993). Cowan and Steel's Manual for the Identification of Medical Bacteria. Cambridge: Cambridge University Press.
- Godkar, P.B. and Godkar, D.P. (2003).Text book of medical laboratory technology. 2nd Ed. Bhalani Publishing House.

Course Title	Networking & Internet of Things			Course Code	NIE 22221		
				Prerequisite	--		
Level	2	Semester	2	Credits	1	Theory (hr)	10
						Practical (hr)	05
						Independent Learning (hr)	35

Aim of the Course:

To provide students with the knowledge in conceptual and technological aspects behind Computer networking.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand fundamental principles of networking, LAN, WAN and PANs standards.
- Differentiate wired and wireless network.
- Familiarize with networking devices, cables, and IOT devices.
- Understand and apply IP addresses.
- Use networking commands.

Course Content:

Fundamentals of data communication, Networking Devices & Cabling, Networking & Protocols, Network Topology, Wired and Wireless network, IP address and URL, Networking Commands for troubleshooting, Introduction to Internet of things

Mode of Assessment and weightage:

- Continuous Assessment (Written tests and Assignments) – 30%
- End Semester Examination – 70%

Course Title	Project Analysis			Course Code	PAE 22232		
				Prerequest	--		
Level	2	Semester	II	Credits	2	Theory (hr)	30
						Practical (hr)	-
						Independent Learning (hr)	70

Aim of the Course:

The aim of the course is to provide students with the knowledge and skills necessary to effectively evaluate and assess the feasibility, viability, and potential impact of various types of projects. Further, it aims to prepare students to make informed and responsible decisions about the initiation, continuation, or termination of projects, taking into account financial, technical, social, and environmental factors. Project Analysis is a critical component of project management and decision making in both business and public sector contexts.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Develop critical thinking and knowledge in project Management's theory and practice.
- Develop the competence of analysing the feasibility of the project.
- Provide analytical skills for solving problems relating to project management.
- Understand how to manage organization's investments in large capital-intensive projects.
- Identify how to make and understand financial decisions and be able to present these back to the stakeholder community.
- Identify how to manage the cash flow of projects and manage and appraise the financial risk mitigation strategies.
- Understand proper cash-flow and sensitivity analyses to forecast and control potential future conditions.
- Define and manage project success factors and maximize the return on the capital invested in projects.
- Understand how to define financial strategies and incorporate these into project risk mitigation strategies.

Course contents:

Introduction to project analysis, Project Cycle, Project Identification, Technical Analysis of Project, Financial and Economic Analysis, Time Value of Money, Capital Investment Decision/ Capital expenditure decision: Non-discounted cash flow approaches and Discounted cash flow approaches, Sensitivity Analysis, Scenario Analysis, Break-even Analysis, Risk Analysis in capital investment decisions, Projected Financial Statements, Project Management and Project Proposal.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Prasannna Chandara (2019) Projects: Planning, Analysis, Selection, Financing, Implementation and Review, published by McGraw-Hill; Ninth edition.
2. Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, published by Wiley, 12th Edition.
3. Phil Baguley, Project Management, Hodder & Stoughton
4. Choudhury S., Project Management, Tata Mgraw Hill
5. Lock Denis, "Project Management", 7th Ed, Gower Publishing Ltd: Vermont

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Principle of Land Surveying</td><td>Course Code</td><td colspan="3">PLE 22242</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">2</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hr)</td><td>30</td></tr>
<tr><td>Practical (hr)</td><td>-</td></tr>
<tr><td>Independent Learning (hr)</td><td>70</td></tr>
</table>

Aim of the Course:

To provide a better understanding and knowledge of Land Surveying, Survey Plans and related technology to apply them in various applications in real life.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the fundamental aspects and principles of Land Surveying.
- Know linear & angular measurements techniques, keep recording of those measurements and corrections applicable on those measurements.
- Identify the fundamental of different surveying and mapping techniques.
- Know to compute coordinates (latitudes and departure) of a position in the earth related to a particular coordinate system.
- Understand the theories and art of preparation of survey plans and area calculations.
- Apply the concept and methods of different modern Survey Techniques and its applications and functions to deal with geographical data

Course Content:

Surveying & Mapping, Linear & Angular Measurements, Coordinate System, Geographical Data, Electronic Distance Measurement, Total station and Global Navigation Satellite System (GNSS)

Mode of Assessment:

- Continuous Assessment (Tutorials, Assignments, Field Visit Report) – 30%
- End Semester Examination – 70%

References:

1. Professor R.Subramanian, (2017), Surveying and Levelling
2. Professor N.M.Basak, (2018), Surveying & Levelling
3. Dr. Alake De (2014), Plane Surveying
4. Dr. B.C.Punmia, Ashok K.Jain & Arun K.Jain, (2011), Surveying Vol. I
5. James M. Anderson & Edward M. Mikhail, (2012), Surveying – Theory and Practice

Course Title	Introduction to Toxicology			Course Code	TOE 22251		
				Prerequest	-		
Level	2	Semester	II	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To provide knowledge to understand how humans respond to chemicals in the environment and learn how toxicology is applied to protect human health through safety evaluation

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand how toxicants enter the body, are metabolized, distributed and excreted from the body.
- Explain the process of carcinogenesis and other ways that cells respond to toxicants.
- Summarize major form and functions of organ systems involved in toxicity.
- Analyze a dose-response curve for a toxicant.
- How the body adapts to xenobiotics in an attempt to maintain homeostasis
- Mechanisms of absorption, distribution, biotransformation and excretion of xenobiotics

Course Content:

What Is Toxicology? Introduction, History of toxicology, Basic definitions,
Are there any non-poisonous substance?
Toxic Agents, Classification of Toxic Agents, Exposure to toxic agents, Toxic depositions: Absorption, Distribution, Target Organs, Target Sites and Mechanisms of Action, Excretion and Metabolism,
Dose: Response and Dose-Response Relationship, Lethal Doses, Threshold Effects for Dose, Xenobiotics, Graded/ quantal dose responses. effects TD50: Median toxic dose, Detoxification of toxic substance, Phase I and Phase II Biotransformation, Aflatoxins, Anti toxins/Antidotes

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. A Textbook of Modern Toxicology, 4th Edition, Ed. Ernest Hodgson, 2010
2. Casarett and Doull's Toxicology: The Basic Science of Poisons. C.D. Klaassen, McGraw Hill, New York.
3. Kent R. Olson. Poisoning and drug overdose (3rd edition).

Course Title	Practical Computational Chemistry			Course Code	CCE 31211		
				Prerequest	-		
Level	3	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

to introduce basic quantum and classical mechanical techniques used in computational chemistry and to apply various software tools

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Solve chemical and molecular modelling problems using spreadsheets.
- Calculate electronic structure properties of small molecules using software packages.
- Visualize the structural properties of macromolecules and ligand binding interactions of proteins using docking software.
- Identify binding poses of drug leads using molecular docking and molecular dynamics
- Predict ADME (absorption, distribution, metabolism, excretion) properties using online serves

Course Content:

Applications of Spreadsheets in computational chemistry, Drawing 2-D chemical structures using Chemdraw and building 3-D structures using Avogadro software, Quantum chemistry calculations of small molecules, Quantum chemistry calculations of small molecules, Protein Database and visualization of macromolecules, Molecular docking Session 1, Molecular docking and virtual screening session 2, Visualizing molecular interactions using Discovery studio, Homology Modelling & ADME, Molecular dynamics simulations, Mini Project, Mini project presentation

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Leach, A.R. (2001). Molecular Modeling: Principles and Applications. Pearson.
2. Leszczynski, J. Handbook of Computational Chemistry; Springer, 2012.
3. Cramer, C. J. Essentials of Computational Chemistry Theories and Models; John Wiley & Sons USA

Course Title	Environmental Economics			Course Code	EEE 31222		
				Prerequest	-		
Level	3	Semester	I	Credits	02	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To enable students to understand the linkages between economic activities and the environment and vice versa.
To discuss the theories and the tools that can be used to understand and measure said relationships so that appropriate decision on how best to manage this environment natural resources can be identified.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the linkages between the various environmental 9E) and Natural resources (NR) problems and the economic activities that affect them.
- Learn how these Environment and Natural Recourse problems could be addressed using appropriate instruments and institution/ properly re… returns.
- Gain familiarity on various techniques that could be used to monetize environmental impacts of economic activities/ programs/ policies, etc.
- Appreciate how benefit cost analysis can be applied in evaluating various resources/ environmental management options.
- Learn different types of environmental standards and their impacts on environment.

Course Content:

Review of microeconomic concepts, Introduction to environmental economics, Economy and environment, Sustainable economy, Economics of pollution, Optimal pollution and role of markets, taxation and optimal pollution, Environmental standards, taxes and subsidies, Marketable pollution permits, Measuring environmental damage: Total economic value, Valuation methodologies, Pollution control policy: Pollution control, Economics of biodiversity and forestry and Economics of pollution

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Leach, Field, B. C., and Field, M. K. 2006. Environmental economics: an introduction. McGraw-Hill series (Economics)
2. Taschenbuch, T. 2003, Environmental and Natural Resource Economics (International Edition)
3. Turner, R.K and Pearce, D.W. 1993.Environmental Economics: An Elementary Introduction.
4. Winpenny, 1991, Values for the environment: A guide to economic appraisal. HMSO, London.

Course Title	English Level V - Business Communication I			Course Code	ELE 31231		
				Prerequest	-		
Level	3	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

This course aims to provide the basic English language competence required for business interactions

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Use discourse markers effectively
- Identify formal and informal texts and extract information from them
- use different forms of written business communication
- use language effectively in general business interactions

Course Content:

Formal and informal greetings/ Politeness markers, Business Correspondence I – emails and memos, Listening: Descriptive/narrative texts (e.g.: discussions, topics related to general interests). Identifying main / supporting ideas, Basic discourse markers, Business Correspondence II – formal letters, Impromptu speeches, Listening: moderately complex instructions. (e.g.: how to operate a C.T. scanner), Describing procedures/ plans, Meaning-making in context, Presenting Visual Information I – tables and diagrams, Presenting Visual Information II – graphs and flowcharts, Listening: Formal recordings/video clips and extract, information (e.g.: graphs, diagrams, tables), Listening: description of places located in a map, Presentation skills.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Student's Manual for ELE 32231 designed by AHEAD project
2. English, J., Burt, S., & Nudelman, G. (2017). Professional communication: Deliver effective written, spoken, and visual messages (4th ed.). Lansdowne, Cape Town:
3. Gurak, L. J., & Lannon, J. M. (2016). Strategies for technical communication in the workplace. 3rd Ed. Pearson.
4. Hewings, M., & Haines, S. (2015). Grammar and vocabulary for advanced: with answers. Cambridge University Press.
5. Lynch, T. (2004) Study listening. 2nd Ed. Cambridge University Press.
6. Mizrahi, J. (2018). Writing for the workplace. Business Expert Press
7. Murphy, R. (2019). English grammar in use: A self-study reference and practice book for intermediate learners of English. 5 th Edition. Cambridge: Cambridge University press.

Course Title	Environmental Policy and Law			Course Code	EPE 31242		
				Prerequest	-		
Level	3	Semester	I	Credits	01	Theory (hrs.)	30
						Practical (hrs.)	-
						Independent Learning (hrs.)	70

Aim of the Course:

To interpret general concepts and principles of environmental legislation.
To Address environmental problems (policy analysis) in order to solve or alleviate them (from a public interest perspective).
To develop the ability to synthesize the factors that contribute to the destruction of the environment and those that can contribute to addressing environmental problems.
To develop the ability to understand, discuss or argue on issues or situations relevant for the present public debate topics, in the context of environmental policy (law, policy, politics, economic, social, technology, ecology).
To apply theoretical concepts to particular cases (for instance, situations of environmental inequity)
To explain fundamental theoretical concepts and their interactions.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe the environmental policies and legislation and apply knowledge to critically evaluate the environmental management policies in Sri Lanka and the world.
- Define relevant legal terms and policy tools presented in class.
- Describe the structure of the major environmental laws.
- Summarize the outcome of major environmental cases.
- Evaluate success of current environmental statutes and rules.
- Formulate potential policy and legal approaches to emerging environmental problems.
- Develop the capacity of the student to identify, analyze, understand environmental problems, in their complex context, at the level of local communities

Course Content:

Environmental policy and environmental law, Environmental conservation and management policies in Sri Lanka and the world, Environmental legislation in Sri Lanka including various aspects of environmental legislation such as Fauna and Flora Protection Ordinance and Development Act, Coast Conservation Act, Forest Ordinance, legislation on local government, other environmental Acts and Status etc., System of approval of development projects and high polluting industries in Sri Lanka, Initial Environmental Examination and Environmental Impact Assessment,: Constitutional provisions in environmental management, environmental management under provincial administration, Environmental standards and rationale for setting environmental standards, Environmental ProtectionLicensing process, Delegation of power and central administration with special reference to environmental conventions and management and International conventions and protocols relevant to global environmental issues.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Student's Constitution of the Democratic Socialist Republic of Sri Lanka.
2. Shayam Divan and Armin Rosencranz. Environmental lawand Policy in India- second edition, Cases
3. Materials and statutes. Oxford University press.
4. Shanthakumar S and Ambedkar. Environmental law- An introduction with Bare Acts and Summery of Cases. Surya Publication- No 66, Sri Nagar Colony, Chennai.
5. The South Asian Environmental Law reporter, Environmental foundation Ltd.
6. South Asia Co-operative environmental programme, Compendium of Summaries of Judicial Decision in Environmental related cases.
7. South Asia Co-operative Environmental Programme, Report of the Regional Symposium on the Role
8. judiciary in Promoting the Rule of Law in the area of Sustainable Development.
9. 7. Bernie P. W. and Boyle A. E., International Law and the Environment.

Course Title	Introduction to Financial Mathematics			Course Code	FME 31251		
				Prerequest	---		
Level	3	Semester	I	Credits	1	Theory (hr)	15
						Practical (hr)	
						Independent Learning (hr)	35

Aim of the Course:

To enable the students to acquire the mathematical concepts and techniques used in basic finance

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Differentiate between the various types of interest rates that can be applied in real world issues.
- Calculate annuities and apply these concepts in real world scenarios.
- Determine possible methods in loan repayment with their applications and the basics of insurance mathematics.
- Explain the theories and foundations of demand and supply together with market equilibrium.

Course Content:

Discounting and Compounding: Simple and compound interest, Annuities, Loans, Single payment problem, Multiple payment problem, Capital budgeting, and Insurance.

Economic Models and Equilibrium analysis: Cost, Revenue, Profit, Elasticities of demand and supply, Marginal cost, Marginal revenue, Profit maximization, and Break-even analysis.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Kellison S. G. (1991). The Theory of Interest (2nd ed.), Irwin, McGraw-Hill.
2. Zima, P. & Brown, R. L. (1996). Schaum's Outline of Mathematics of Finance. McGraw-Hill.
3. Chiang, A. C. & Wainwright, K. (2005). Fundamental Methods of Mathematical Economics. (4th ed.). Jurong, Singapore: McGraw-Hill

Course Title	Laboratory and Quality Management			Course Code	LME 31261		
				Prerequest	-		
Level	3	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

Use laboratory skills in industrial applications and accumulate work place skills that will help them in their future careers. Validate methods and data, quality assurance of products, and concept of intellectual property rights.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Use laboratory skills in industrial applications and accumulate work place skills that will help them in their future careers.
- Validate methods and data, quality assurance of products, and concept of intellectual property rights.

Course Content:

Industrial standardization: Historical development, Total Quality Management: Leadership for Quality and Human Resources Management; Management of Quality: Quality systems, ISO 9000 standard, Quality manual and Quality auditing. SLNQA scheme, Introduction to ISO 14000 standard on environmental management systems: Economics of quality and poor-quality customer focus and customer ease, Vendor (Supplier) Relations, Inspection planning.

Techniques for Quality Improvement: Introduction to the 7 basic tools of quality control, Introduction to new management tools, Problem-solving process; Good Laboratory Management: Management commitment independent quality assurance unit properly equipped and well-maintained facilities, properly trained personnel and Implementation.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Organization, W. H., Laboratory quality management system: handbook. World Health Organization: 2011
2. Hibbert, D. Brynn. "Bernd W. Wenclawiak, Michael Koch, Evsevios Hadjicostas (Eds.): Quality assurance in analytical chemistry: training and teaching. (2011): 331-332.

Course Title	Research Methodology			Course Code	RME 31272		
				Prerequest	---		
Level	3	Semester	I	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To give comprehensive understanding on all aspects of research.
To evaluate literature, from a variety of sources, relevant to the research objectives.
To provide in-depth understanding of data collection methods and data analysis tools.
To provide guidance in research proposal writing and scientific report writing.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Demonstrate the ability to choose methods appropriate to research aims and objectives
- Understand the limitations of particular research methods
- Develop skills in qualitative and quantitative data analysis and presentation
- Develop advanced critical thinking skills
- Demonstrate enhanced writing skills

Course Content:

Introduction to the course, Introduction to Research and Research Process, Research Paradigms and Types of Research, Formulating research questions and problems, Literature review, Research steps and process, Research objectives, Developing questionnaire, Introduction to Sampling Methods, Sampling Methods techniques, Research Design, Methods of Data Collection –Quantitative vs Qualitative, Survey Methods and Sampling Surveys, Formulation of Research Proposal Presentation of Research Findings, Proposal writing steps, Report Writing, Presentation of data, Type of Variables, Scientific writing, Data collection techniques in Research, Presentations of data (tabular), Scientific writing, Scientific Misconduct and plagiarism in Research.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.
2. Kothari C., R. (2004). Research Methodology: Methods and Techniques. New Delhi. New Age International (P) Limited, Publishers.
3. Krueger, A. R. (1994). Focus Groups: A Practical guide for Applied Research, Thousand Oaks, CA: Sage Publications.
4. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed.), Singapore, Pearson Education.
5. Strauss, A. & Corbin, J. (1994). "Grounded Theory Methodology." In NK Denzin & YS Lincoln (Eds.) Handbook of Qualitative Research (pp. 217-285).

Course Title	Data Acquisition and Signal Processing			Course Code	DSE 32212		
				Prerequest	Electronics		
Level	3	Semester	II	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To give comprehensive understanding on the data acquisition systems, memories and operations

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand the data acquisition systems
- Understand the preliminary concepts of microprocessors
- Explain the Analogue to Digital Converters, Digital to Analogue Converters and various types of signal processing systems

Course Content:

Introduction to data acquisition systems; controlling external devices; Interfacing between logic families, Driving Digital logic from comparators and Opamps, Systems, system dynamics, system applications, Laplace transformations, bridge circuits (nonlinearity/sensitivity, lead resistance error, signal conditioning electronics), Strain gages, High impedance sensors and measuring electronics (photodiodes, humidity monitors, chemical sensors etc.), Temperature sensors and measuring electronics (Thermocouple, RTD, Thermisters, Semiconductor temperature sensors), Special sensors, Signal conditioning (noise analysis and noise elimination techniques), Active filter design, shaping methods, Trigger techniques, Discriminators. Introduction to microprocessors preliminary concepts; components of a microprocessor; memory; programming's microprocessor; motorola MC 6809 processor; ISA Bus, standard interfaces. Digital to Analogue Converters (DACs), Scaled current sources, Generating voltages from current output DACs, Time-domain (averaging) DACs, Multiplying DACs, Analogue to Digital Converters (ADCs), Parallel Encoder, Successive-approximation ADC, Voltage-to Frequency Conversion, Single-slope Integration, Charge-balancing technique, Dual-Slope Integration, Delta-Sigma converters, Switched-Capacitor ADC, Some A/D Conversion examples, Decoders and Encoders, Multiplexing, Bandwidth-Narrowing Techniques, Signal-to-noise computation, Signal averaging, Spectrum Analysis and Fourier Transforms.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Nikolay V. Kirianaki, Data Acquisition and Signal Processing for smart sensors, John Wiley & Sons Ltd
2. Kurosh Madani, Advanced Data Acquisition and Intelligent Data Processing (English Edition), River Publishers

Course Title	Environmental Impact Assessment			Course Code	EIE 32222		
				Prerequest	-		
Level	3	Semester	II	Credits	2	Theory (hr)	30
						Practical (hr)	
						Independent Learning (hr)	70

Aim of the Course:

To introduce the EIA process used for research, planning, project or program evaluation, monitoring, and regulatory enforcement;
To develop knowledge on the legal, economic, administrative and technical process of preparing and/or evaluating environmental impact documents

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand Demonstrate knowledge on Environmental Impact Assessment process and environmental monitoring methods.
- Address the issues related to environment during the processes of construction and implementation of new development projects.
- Explain the importance of EIA for sustainable development.
- Demonstrate skills in application of EIA in development projects and common techniques used in monitoring the environmental quality.

Course Content:

Introduction to Environmental Impact Assessment (EIA), Steps in EIA, EIA methods, EIA process, Problems associated with EIA process in developing countries and potential solutions, Myths about EIAs, Incorporation of impacts and their mitigation into the process, Use of EIA as a decision making tool for achieving sustainable development. Case studies. Importance of environmental monitoring for environmental impact assessment, Main parameters to be monitored in key environmental issues: physical parameters, chemical parameters, biological parameters, socio-economic parameters, legal aspects of EIA, design of a monitoring programme, Techniques commonly used in chemical and biological monitoring of the environment, Environmental sampling and analysis, Quality assurance and Safety procedures

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Canter, L.W., (1996) Environmental Impact Assessment, Second Edition, McGraw Hill Publishing Company, Inc., New York.
2. Gilpin, A., (1995). Environmental Impact Assessment (EIA) – Cutting edge for the Twenty First Century, Cambridge University Press, Cambridge, England,.
3. Vanclay, F., and Bronstein, D.A., (1995) Environmental and Social Impact Assessment, John Wiley and Sons Ltd., Chichester, England,

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">English Level VI - Business Communication II</td><td>Course Code</td><td colspan="3">ELE 32231</td></tr>
<tr><td>Prerequest</td><td colspan="3">ELE 31231</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">1</td><td>Theory (hr)</td><td>15</td></tr>
<tr><td>Practical (hr)</td><td></td></tr>
<tr><td>Independent Learning (hr)</td><td>35</td></tr>
</table>

Aim of the Course:

This course aims to provide advanced English language competence required for business interactions

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Distinguish implicit and explicit ideas from formal and informal texts
- Identify main and supporting ideas from a recording / video
- Use advanced language structures in written and oral business communication
- Communicate effectively in a variety of professional settings

Course Content:

Listening: Formal and informal texts, Writing I - CV and Cover Letters, Writing II – Business Letters, Listening: Formal and informal multi speaker interactions (e.g.: attitudes, opinions, suggestions, stances), Persuasion, Argumentation, Negotiations, Meeting skills, Listening: News items / formal meetings / documentary Identifying main points, Report Writing I, Report Writing II, Listening: Radio / tv programs , Identifying main ideas, Summary Writing, Listening: Moderately complex recordings Identifying explicit and implicit meanings. (e.g.: formal conversations, discussions), Presentation skills

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Student's Manual for ELE 32231 designed by AHEAD project.
2. English, J., Burt, S., & Nudelman, G. (2017). Professional communication: Deliver effective written, spoken, and visual messages (4th ed.). Lansdowne, Cape Town: Juta. ISBN 978 1 48511 712 4
3. Gurak, L. J., & Lannon, J. M. (2016). Strategies for technical communication in the workplace. 3rd Ed. Pearson.
4. Hewings, M., & Haines, S. (2015). Grammar and vocabulary for advanced: with answers. Cambridge University Press. ISBN 13:9781107481114
5. Lynch, T. (2004) Study listening. 2nd Ed. Cambridge University Press.
6. Mizrahi, J. (2018). Writing for the workplace. Business Expert Press

Course Title	Food Science			Course Code	FSE 32241		
				Prerequest	-		
Level	3	Semester	II	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

To impart knowledge and develop skills of students on the fundamentals of food science and its application.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Acquire the basic criteria of food and water standards for consumption
- Gain the basic idea about the chemical constituents of food
- Explain the various food additives, their chemical composition and their permissible level of usage in foods.
- Investigate the various organisms which spoil the crops pre and post-harvest and their control using pesticides

Course Content:

Origins of food chemistry; composition and properties of fat, carbohydrates, proteins, lipids, vitamins, minerals, antioxidants and enzymes, etc. principle and methods of preservation, food packing and packing material, food analysis; analytical methods to estimate moisture, colloids, fat, sugar, additives, food colors, flavors and odors, food hazards/contaminants etc., food laws, safety and regulations.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Owen R Fennema, "Food Chemistry", Marcel Decker Inc., New York. 1996.
2. M. Swaminathan "Text Book on Food chemistry", Printing and Publishing CO., Ltd. 1993.

Course Title	Geotechnical Engineering			Course Code	GEE 32252		
				Prerequest	-		
Level	3	Semester	II	Credits	02	Theory (hr)	30
						Practical (hr)	-
						Independent Learning (hr)	70

Aim of the Course:

To impart knowledge and an understanding of geotechnical engineering to be familiarize with geotechnical design concepts commonly encountered in engineering practices.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Measure basic engineering properties of soils and geotechnically characterize soils for engineering applications including ground improvement and geo-hazard management.
- Analyze stress distribution of soils and properties of active and passive earth pressure for design of a simple earth retaining structure.
- Determine shear strength parameters of soils and be familiarize with limit equilibrium concepts for analysis of slope stability.
- Apply the knowledge of Terzarghi's theory and bearing capacity for design of a simple shallow foundation.

Course Content:

Basic Characterization of soil, Stability of slopes, Lateral Earth Pressure and Retaining walls, Soil Bearing capacity and Foundations, Ground Improvement and Geohazard Management

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Practical/Field Reports Assignments, Tutorial Assignments, Oral Presentation etc.) – 30%
- End Semester Examination – 70%

References:

1. Abramson, LW 2002, Slope stability and stabilization methods, 2nd edn, John Wiley & Sons.
2. Coduto, DP 2011, Geotechnical Engineering: principles and practices.2nd edn, Pearson.
3. Craig, RF 2004, Soil Mechanics, Chapman & Hall, 7th edn, New York.
4. Das, BM 2008, Fundamentals of geotechnical engineering, 4th edn, Nelson.
5. Robert, WD 1999, Geotechnical and foundation engineering: design & constructions, McGraw-Hill.
6. Bowles, JE 1997, Foundation analysis and design, 5th edn, McGraw Hill.
7. Laming, DJC, Mccall, GJH & Scott, SC 1992, Geohazards: natural & man-made, Springer
8. Mccall, GJH, Laming, DJC & Scott, SC 1990, Geohazards: natural & man-made, Journal of the geological society, 147: 879-881.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Intensive Industrial Training</td><td>Course Code</td><td colspan="3">IIE 32262</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hrs.)</td><td>-</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>200</td></tr>
</table>

Aim of the Course:

To produce science graduates who are skilled in the variety of industrial activities specified by the Sri Lankan industries through connecting the classroom to real-world

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Improve personal maturity and professional attitude
- Familiarize present-day needs of Sri Lankan employers in the field of Applied Science
- Conduct an independent literature review on a selected topic recognize methods used to analyze quantitative and qualitative data
- Apply statistical methods to analyze quantitative data
- Write a formal scientific report on a selected topic and make a presentation on a selected topic

Course Content:

The intensive Industrial Training program is a GPA-type elective course, which will be offered in the second semester of level III for a period of 8-weeks. The students who have completed the 5th semester of their general degree will be selected for the program depending on their demand. The number of placements will be increased every year with regard to the student's demand and industrial linkages. If the student's demand is greater than the granted number of placements, the selection is based on their overall running GPA up to 4h semester. Each registered student will undergo full-time training in the industry for the recommended period on projects assigned by the industry and is expected to attain hands-on capabilities in their subjects as well as other related fields such as, administration, management, sustainable development, work ethics, safety, quality control, etc. Throughout their stay in the industry, they should, (i) maintain a daily diary and (ii) submit their employer's report every two weeks. In addition, two weeks after the completion of the training program, the students should, (i) submit a comprehensive report and (ii) present their projects. All the details related to intensive industrial training (e.g. eligibility, placement, assessment methods, etc.) can be found in 'Guidelines for Intensive Industrial Training' issued by the Industrial Cell of the Faculty.

Mode of Assessment and weightage:

Attendance–15%, Diary–15%, Employers Report- 30%, Report and Presentation - 40%

References:

1. Blackwell, J., & Martin, J. (2011). A scientific approach to scientific writing. Springer Science & Business Media.
2. Creme, P., & Lea, M. (2008). Writing at university: A guide for students. McGraw-Hill
3. Swales, J. M., & Feak, C. B. (2004). Academic writing for graduate students: Essential tasks and skills (Vol. 1). Ann Arbor, MI: University of Michigan Press.
4. Whetten, D. A. and Cameron, K. S. (2019) Developing management skills10th Ed

Course Title	Multimedia & Graphics			Course Code	MGE 32272		
				Prerequisite	--		
Level	3	Semester	2	Credits	2	Theory (hrs.)	10
						Practical (hrs.)	20
						Independent Learning (hr)	70

Aim of the Course:

To provide students with the knowledge of multimedia and graphics techniques.

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Understand image compression and bitmap images
- Familiarize with image editing software, web graphics tool and vector drawing.
- Demonstrate photography, image processing, multimedia system sounds, video editing and animation.

Course Content:

Image Compression, Bitmap images, Graphics Tools, Image editing software: Industry standard - Adobe photoshop, Web graphics tool and Vector drawing, Vector images, Photography, Basic Image Processing, Multimedia system sounds, Video editing & animation, Mini project in multimedia design, photoshop, animation etc.

Mode of Assessment and weightage:

- Continuous Assessment (Written tests, Practical Assignments and Mini projects) – 30% (15% for Theory & 15 % for practical)
- End Semester Examination – 70%

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Bioethics</td><td>Course Code</td><td colspan="3">BEE 32281</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
</table>

Aim of the Course:

To introduce the students to bioethics, it's basic principles, theories and contemporary issues as a source of inspiration to the descipline.
To help students develop systematic strategies for analysing bioethical dilemmas

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Describe the ethical principles and theories
- Relate historical events to development of bioethical concepts/theories
- Identify ethical issues in medicine, health care, life sciences and environmental issues.
- Formulate their own moral positions, by class discussions/debates
- Provide rational justification for ethical decisions

Course Content:

Ethics: ethics and it's importance, ethical principles and theories; **Bioethics:** bioethics and the need for it, human values, history and development as a discipline, human experimentation, informed consent, prominent ethical codes, principles of bioethics; Bioethical topics: surrogacy, abortion, organ transplantation, euthanasia etc.; environmental ethics and ethical decision making.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home takeAssignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Introduction To The Principles Of Bioethics, John French. Canadian Journal of Medical Radiation Technology. Volume 37, Issue 1, Spring 2006, Pages 31-36

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">Computational Physics</td><td>Course Code</td><td colspan="3">CPE 32292</td></tr>
<tr><td>Prerequest</td><td colspan="3">-</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">3</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">02</td><td>Theory (hrs.)</td><td>30</td></tr>
<tr><td>Practical (hrs.)</td><td></td></tr>
<tr><td>Independent Learning (hrs.)</td><td>70</td></tr>
</table>

Aim of the Course:

To introduce the students to provide a strong background in numerical analysis and computational techniques related to the Physics

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify modern programming methods and describe the extent and limitations of computational methods in physics,
- Identify and describe the characteristics of various numerical methods.
- Independently program computers using leading-edge tools,
- Formulate and computationally solve a selection of problems in physics,
- Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.

Course Content:

Develop mathematical functions, linear and non-linear situations and modeling of practical scenarios, Interpolation and extrapolation, Visualization of 2D & 3D functions, Develop histogram, Bar charts and pie charts for data, Import and export of image, Manipulation of Physical scenarios, mathematical modeling, Object animation, Develop sound and wave's for practical situations.

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Computation Physics: Problem Solving with Python, 3rd Edition by Rubin H. Landau, Manuel J Páez, Cristian C. Bordeianu.
2. Computation in Modern Physics, 3rd Edition by William R. Gibbs
3. Applied Computational Physics by Eric S. Swanson and Joseph F. Boudreau

Course Title	English Level VII - Professionals			Course Code	ELE 41211		
				Prerequest	-		
Level	4	Semester	I	Credits	01	Theory (hrs.)	15
						Practical (hrs.)	-
						Independent Learning (hrs.)	35

Aim of the Course:

This course aims to provide the English language competence required to function in an Industrial setting specific to graduates of applied sciences

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify features of formal and informal spoken interactions
- Discuss techniques of note taking
- Produce spoken and written evaluations
- Make technical/academic presentations
- Communicate effectively in technical settings

Course Content:

Formal Correspondence – memo writing, invitation, emails, Listening: Formal and informal interactions, Identifying features of formal and informal interactions, Interpretation, Inferring, Listening: Academic texts, Identifying topics, subtopics, supporting details, Academic Writing I – research articles, Academic Writing II – research proposals, Note taking: Abbreviations, symbols, stress, intonation, discourse markers (signpost language), Conducting Evaluations, Paraphrasing and Summarizing Reporting, Technical/academic presentations, Note taking: Instructions, Take down notes while listening, Writing minutes

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. English, J., Burt, S., & Nudelman, G. (2017). Professional communication: Deliver effective written, spoken and visual messages (4th ed.). Lansdowne, Cape Town:
2. Gurak, L. J., & Lannon, J. M. (2016). Strategies for technical communication in the workplace. 3rd Ed. Pearson.
3. Hewings, M., & Haines, S. (2015). Grammar and vocabulary for advanced: with answers. Cambridge University Press.
4. Lynch, T. (2004) Study listening. 2nd Ed. Cambridge University Press.
5. Mizrahi, J. (2018). Writing for the workplace. Business Expert Press
6. Murphy, R. (2019). English grammar in use: A self-study reference and practice book for intermediate learners of English. 5 th Edition. Cambridge: Cambridge University press.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="3" rowspan="2">English Level VIII - Graduate Studies</td><td>Course Code</td><td colspan="3">ELE 42211</td></tr>
<tr><td>Prerequest</td><td colspan="3">ELE 41211</td></tr>
<tr><td rowspan="3">Level</td><td rowspan="3">4</td><td rowspan="3">Semester</td><td rowspan="3">II</td><td rowspan="3">Credits</td><td rowspan="3">01</td><td>Theory (hrs.)</td><td>15</td></tr>
<tr><td>Practical (hrs.)</td><td>-</td></tr>
<tr><td>Independent Learning (hrs.)</td><td>35</td></tr>
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Aim of the Course:

This course aims at familiarizing students with the IELTS/TOEFL tests and assists them to obtain the scores required to enroll in postgraduate programmes at the M.Sc. and/or PhD level

Intended Learning Outcomes:

On the successful completion of the course, students should be able to:

- Identify specific information from monologues, dialogues, and conversations
- Extract information from texts belonging to a variety of registers and genres
- Write essays on academic and general topics
- Master study skills needed to succeed in the TOEFL and IELTS tests

Course Content:

General Reading, Academic Reading, Interpreting tables, diagrams, graphs and charts Describing main stages of a process, Letter writing : Formal, semi-formal and personal letters, Essay writing: Academic and general topics, Listening: Monologue/dialogue, Listening: Conversation, Listening to a description: diagrams, maps and plans, Listening: Panel discussions/documentaries, Listening: Academic lectures/talks, Self-introduction ,Describing personal experiences, Talking about likes and dislikes, Impromptu speeches: 2 minutes, Elaborating on a topic, Expressing opinions, Building and defending arguments/ claims, Integrated speaking tasks: listening and speaking/ listening, reading and speaking

Mode of Assessment and weightage:

- Continuous Assessment (MCQ, Short answer questions, Home take Assignments, closed book essay type examination) – 30%
- End Semester Examination – 70%

References:

1. Cambridge IELTS 13 academic student's book with answers. (2018). Cambridge University Press.
2. Cullen, P., French,A., Jakeman, V. (2014). The official Cambridge guide to IELTS - Student's book with answers. Cambridge English
3. Educational Testing Service. (2016). Official TOEFL iBT Tests. New York: McGraw-Hill Education
4. Educational Testing Service. (2017). The official guide to the TOEFL test (5th ed.). New York: McGraw-Hill Education
5. Jakeman, V & McDowell, C (2008) New Insight into IELTS. Student's book with answers. Cambridge University Press.