Share the Subject Proposal with	
Please select the committee for Approval	PGPEC
1.Name of the Dept:	Mining Engineering
2.Name of the Subject:	Georesources Analytics
** 3.LTP and Credit:	L-T-P 3-1-0 Credit: 4
4.Status of the subject:	
** a) Specify the Session, Semester ,from which the subject is going to be offered	Autumn, 2019-20
** b)Please Specify the Level of the Subject:	PG level
** c) Whether the subject will be offered as compulsory or elective:	Elective
** d) The semester in which the subject will be offered:	Autumn
** e) Name(s) of the Programme(s) in whose curricula this subject will be included:	4th year UG, 5th year DD, 1st year M Tech, RS
5.Prerequisite(s) for the subject, if any (Please give the subject numbers and names):	MA20104, Probability & Statistics
* 6.Objective and Contents:	
** a) Objective:	With the growing mechanization and automation commensuration with low cost data gathering, storage and processing, mining industry is now in greater need and in stronger motivation for using data analytics in real life problem solving. Knowledge and application of analytic tools in the georesources field would certainly help the students to comprehend the problem in better way. The objective of this course is to impart the students with the knowledge of advanced georesources data analytic tools which would prompt them to make managerial decision to solve real-life mining problems. With the emphasis on basic theory, tutorials and introduction of real-life georesources data, this course will provide a holistic view on data analysis. This course will enable the students to (i) gather an exposure to various data types and understand their sources, and basic knowledge on the concept of experimental design for data generation, (ii) display and analyze various data

	through data visualization technique and statistical analysis tools, (iii) apply different classification and regression tools for prediction and fault diagnosis.
** b) Contents (in 100 to 150 words):	**Unit 1- Introduction to georesources data** [3 hours] Data types: qualitative and quantitative Data sources- geo-spatial, geo-environment, geomechanics, and safety Data collection and Reporting-manual and online: a. Grade attribute and lithological data b. rock testing, c. Mine accident data, d. well-log, e. online survey and sensor data from different georesources applications. **Unit 2- Data visualization and analysis** [4 hours] Univariate: Descriptive statistics; inferential statistics- t test, chi-square test, F test, Analysis of Variance Multivariate: Scatter plot, P-P plot, Q-Q plot, multivariate distribution, Mahanalobis distance, Test of association **Tutorials**: concept demonstration using grade attributes data [2] **Unit 3- Regression and classification of georesources data** [4 hours] Introduction to the concept of regression and classification; georesources data classification problems: a. lithological classification b. roof fall diagnostic c. rock images classification d. machine fault diagnostic through condition monitoring. Regression problems: a. Metal price forecasting b. spatial regression for grade estimate, c. environmental quality parameters d. Mine injury data

Unit 4- Linear classification and Regression techniques [11 hours]

Concept of Bayes classifier; Different Liner classifiers, Fisher's discriminant analysis

Regression: simple regression and multiple regression; ordinary least square and generalized least-square algorithm.

Spatial regression: variogram modeling and Kriging.

Dimension reduction techniques: principal component analysis, factor analysis

Tutorials: [6 hours]

a. rock types classification using lithological data,
b. metal price forecasting using historical price data,
b. spatial regression using grade attribute data,
c. principal component analysis and factor analysis using Mine safety data

Unit 5:Non-linear regression and classification techniques with supervised learning [10 hours]

Concept of Artificial Neural network; multilayer perceptron and learning algorithms: back-propagation learning; variation of backpropagation learning algorithms: gradient descent, Leavenberg and Marquardt algorithm; Support vector machine as regression and classification models.

Tutorials: MPL model for lithological classification, feedforward network model for grade and resource estimation, SVM and MLP on well log data [4 hours]

Unit 6:Unsupervised Learning and clustering [3 hours]

k-mean clustering; hierarchical clustering; associative learning and Kohonen network

Tutorials: Ore zone clustering using grade attribute data [1 hour]

** 7.Names of the faculty members of the Department/Centers/School who have the neccessary expertise and will be the willing to teach the subject (Minimum two faculty members should be willing to teach the subject)	1. B. Samanta, Mining 2. A. Bhattacherjee, Mining 3. D. Chakravarty, Mining 4. D. Deb, Mining
** 8.Do the contents of the subject have an overlap with any other subject offered in the Institute?	
** If yes, please check and give details as follows ☐	
a)Subject Name:	CS60050, Machine Learning IM 60061, Applied Multivariate Statistical Modelling – I
b) Approximate percentage of overlap:	<10%
c) Reasons for offering the new subject in spite of the overlap:	The overlap is not considerably high. The most of the overlap is in the basic concept of statistics, regression and classification techniques. Further, this is a new course in the domain of mining which has specificity in application and treatment of data
** 9.Recommended Text Books/References Books	
** a) Theory (Text Books):	1. Johnson, R.A. and Wichern, D.W., Applied Multivariate Statistical Analysis, PHI, Delhi, 2013. 2. Ross, S.M., Introduction to Probability Models, Elsevier, New Delhi, 2010 3. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., Multivariate Data Analysis, Pearson Education Limited, United Kingdom, 2013 4. Stern, R. Good Statistical Practice for Natural Resources Research, Statistical Services Centre, University of Reading, UK, 2004 5. T J Napier-Munn, Statistical methods for mineral engineers- how to design experiments and analyse data, JKMRC monograph series in mining and mineral processing, 2014 6. John Lucas, Mines and Mineral statistics, 2013, ISBN-10: 5518633939

	7. A.G. Journel and Ch. J. Huijbregts, Mining Geostatistics, academic Press, 1981 8. Holdaway, K. R., Harness Oil and Gas Big Data with Analytics: Optimize Exploration and Production with Data-Driven models, 1st edition, Wiley and SAS Business Series, 2014 9. Haykins, S., Neural Networks and Learning Machines, Pearson, Canada, 2009 10. Hagan, M. T., Demuth, H. B., Beale, M. H., Orlando De Jesús, O., Neural Network Design, 2nd edition, 2014
** b) References (Literature):	1. Wu X, Zhou Y. Reserve estimation using neural network techni 4, pp. 567575, Pergamon Press, 1993 2. King, R.L., Hicks, M.A., and Signer, S.P., Using Unsupervised Coal Mine Roof. Engineering Applications of Artificial Intelligenc 3. Maxwell, A.P., Denby, B., and Pitts, W., The Application of Ne Minerals on Conveyors. 25th International Symposium on the App Operations Research in the Minerals Industries (APCOM), Brisbar 4.Sanmiquel, L.; Rossell, J.M.; Vintr, C., study of Spanish mining Accidents using data mining techniques, safety science, 2015, 49-55
** 10.Names of Departments/Centers/Schools/Programmes whose students are expected to resgiter for this subject	1. Mining Engineering 2. Geology and Geophysics 3. Petroleum Engineering Centre