

## PROBLEM DESCRIPTION

Indian institute of technology, Bombay offers 210 post graduate courses for the students of various disciplines. Many of these courses are interdisciplinary and students from various branches take the courses. For example, the course in linear programming (code MG 654) is taken by the students of Electrical Engineering, Management, and Aerospace Engineering. The student section of the institute keeps a file which records the code number of courses taken by all the students (around 1500 in number) in the institute. Institute face major problems while conducting the examinations as the institute policy stipulates that examinations should be over in 7 days (2 sessions per day). The institute has 30 class rooms. Formulate the problem to give the examination schedule. The requirements are: 1) No student should be asked to take more than 1 examination at the same time, 2) The maximum number of examinations that can be scheduled at any one time is limited by the number of class rooms, 3) As far as possible a student need to take only one examination per day.

## SETS AND INDICES

<i>Sets</i>	<i>Description</i>	<i>Indices</i>
<i>C</i>	Set of courses (1 to 210)	$c \in C$
<i>S</i>	Set of students (1 to 1500)	$s \in S$
<i>T</i>	Set of exam slots (Morning, Afternoon)	$t \in T$
<i>D</i>	Set of days (1 to 7)	$d \in D$

## PARAMETERS

<i>Parameter</i>	<i>Description</i>	<i>Unit</i>
<i>CS<sub>cs</sub></i>	1 if course <i>c</i> is allocated to student <i>s</i> , 0 otherwise	-
<i>NumClassrooms</i>	Number of classrooms available	-

## DECISION VARIABLES

<i>Decision Variable</i>	<i>Description</i>	<i>Unit</i>	<i>Type</i>	<i>Bounds</i>
<i>Exam<sub>ctd</sub></i>	1 if course <i>c</i> has exam allotted in slot <i>t</i> on day <i>d</i>	-	Binary	{0,1}
<i>StudentExam<sub>sctd</sub></i>	1 if student <i>s</i> having course <i>c</i> has exam allotted in slot <i>t</i> on day <i>d</i>	-	Binary	{0,1}
<i>pen<sub>sd</sub></i>	Penalty if student <i>s</i> has to give 2 exams on the same day <i>d</i>	-	Binary	{0,1}

## OBJECTIVE FUNCTION

$$Penalty = \sum_{s \in S} \sum_{d \in D} (pen_{sd})$$

$$\text{Minimise } OBJ = Penalty$$

## CONSTRAINTS

(1) Each course can have only one exam

$$\sum_{t \in T} \sum_{d \in D} (Exam_{ctd}) = 1 \quad \forall c \in C$$

(2) Maximum number of exams at the same time can't exceed the number of classrooms – satisfies condition 2 - The maximum number of examinations that can be scheduled at any one time is limited by the number of class rooms

$$\sum_{c \in C} (Exam_{ctd}) \leq NumClassrooms \quad \forall t \in T, \forall d \in D$$

- (3) Each student can give maximum one exam in each slot per day – satisfies condition 1 - No student should be asked to take more than 1 examination at the same time

$$\sum_{c \in C} (StudentExam_{sctd}) \leq 1 \quad \forall s \in S, \forall t \in T, \forall d \in D$$

- (4) Choosing which slot on which day a student can give the exam

$$StudentExam_{sctd} = CS_{cs} * Exam_{ctd} \quad \forall c \in C, \forall s \in S, \forall t \in T, \forall d \in D$$

- (5) Penalty if a student has to give more than one exam on the same day – satisfies condition 3 - As far as possible a student need to take only one examination per day

$$\sum_{c \in C} \sum_{t \in T} (StudentExam_{sctd}) \leq 1 + pen_{sd} \quad \forall s \in S, \forall d \in D$$