

# JK LAKSHMIPAT UNIVERSITY, JAIPUR

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov.-Dec. 2017

B. Tech in Mechanical Engineering, Semester V

Roll No.....

ME506: Industrial Eng. & Operation Research

Time: 3 hours

Max. Marks: 100

### Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

|       |                                                                                                                                                                                                                                                  |    |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Q.1A  | Objective type multiple choice questions (10 questions @ 1 mark)                                                                                                                                                                                 | 10 |
| i.    | Bar chart is suitable for<br>a) large project   b) major project   c) minor project   d) all of these                                                                                                                                            |    |
| ii.   | Work sampling is used for<br>a) estimation of the percentage utilization of machine tools<br>b) estimating the percentage of time consumed by various job activities<br>c) finding out time standard<br>d) all of the above                      |    |
| iii.  | Dummy activities are used to<br>a) determine the critical path      b) determine the project completion time<br>c) maintain the require network   d) none of these                                                                               |    |
| iv.   | A critical activity has<br>a) maximum slack      b) minimum slack      c) zero slack      d) none of these                                                                                                                                       |    |
| v.    | Critical path method<br>a) helps in ascertaining time schedule<br>b) makes better and detailed planning possible<br>c) provides a standard method for communicating project plans schedules and time and cost performance<br>d) all of the above |    |
| vi.   | PERT analysis is based upon<br>a) optimistic time   b) pessimistic time   c) most likely time   d) all of these                                                                                                                                  |    |
| vii.  | Actual performance task is called<br>a) an event      b) an activity      c) a duration      d) none of these                                                                                                                                    |    |
| viii. | A diagram showing the path followed by men and materials while performing a task is known as<br>a) string diagram      b) flow process chart      c) travel chart      d) flow diagram                                                           |    |
| ix.   | Performance rating is equal to<br>a) observed performance + normal performance<br>b) observed performance - normal performance<br>c) observed performance $\times$ normal performance<br>d) none of the above                                    |    |
| x.    | PERT is preferred over CPM for the purpose of project evaluation. (Yes/ No)                                                                                                                                                                      |    |

| Q.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Short answer type questions (4 questions @ 2.5 marks)                                                                                                                                                                                                                                                                                                                                                                                                | 10       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
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| i.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | What are the Factors that directly affects the selection of Material Handling Equipment?                                                                                                                                                                                                                                                                                                                                                             |          |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| ii.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Define Performance Rating.                                                                                                                                                                                                                                                                                                                                                                                                                           |          |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| iii.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Express your view about <i>PMTS</i> (Predetermined motion time standard).                                                                                                                                                                                                                                                                                                                                                                            |          |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| iv.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Define simplex method of linear programming.                                                                                                                                                                                                                                                                                                                                                                                                         |          |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.3A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Distinguish between micro and macro motion study techniques.                                                                                                                                                                                                                                                                                                                                                                                         | 05       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.3B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Distinguish between the features of <i>PERT</i> and <i>CPM</i> ?                                                                                                                                                                                                                                                                                                                                                                                     | 05       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.4A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Explain the Concept of Value Engineering and what are its applications?                                                                                                                                                                                                                                                                                                                                                                              | 05       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.4B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | What are the factors that affects rate of working?                                                                                                                                                                                                                                                                                                                                                                                                   | 05       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.5A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A project consists of series tasks labelled A, B, ....., H, I with the following relationships ( <i>W</i> < <i>X</i> , <i>Y</i> means <i>X</i> and <i>Y</i> can't start until <i>W</i> is completed; <i>X</i> , <i>Y</i> < <i>W</i> means <i>W</i> can't start until both <i>X</i> and <i>Y</i> are completed). With this notation construct the network diagram having the following constraints:<br>$A < D, E; B, D < F; C < G; B < H; F, G < I$ . | 05       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.5B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Write statements of the Fulkerson's Rule of numbering the Events?                                                                                                                                                                                                                                                                                                                                                                                    | 05       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.6A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | What are the purposes of Micro Motion Study? Explain with motion economy principles                                                                                                                                                                                                                                                                                                                                                                  | 10       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.6B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A Solve the following LPP using its dual<br>$Max\ Z = 5x_1 - 2x_2 + 3x_3$<br>Subject to $2x_1 + 2x_2 - x_3 \geq 2, \ 3x_1 - 4x_2 \leq 3, \ x_2 + 3x_3 \leq 5$<br>and $x_1, x_2, x_3 \geq 0$                                                                                                                                                                                                                                                          | 10       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| OR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.6B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A Using dual simplex method solve<br>$Minimize\ Z = 2x_1 + 2x_2 + 34$<br>Subject to $2x_1 + 3x_2 + 5x_3 \geq 2, \ 3x_1 + x_2 + 7x_3 \leq 3, \ x_1 + 4x_2 + 6x_3 \leq 5$<br>and $x_1, x_2, x_3 \geq 0$                                                                                                                                                                                                                                                | 10       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| Q.7A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Draw the network diagram for the following list of activities and do numbering of the events:                                                                                                                                                                                                                                                                                                                                                        | 15       |                       |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| <table><tr><th>Activity</th><th>Immediate Predecessor</th><th>Activity</th><th>Immediate Predecessor</th></tr><tr><td>A</td><td>-</td><td>L</td><td>K</td></tr><tr><td>B</td><td>A</td><td>M</td><td>K</td></tr><tr><td>C</td><td>B</td><td>N</td><td>K</td></tr><tr><td>D</td><td>C</td><td>O</td><td>D</td></tr><tr><td>E</td><td>D</td><td>P</td><td>O</td></tr><tr><td>F</td><td>E</td><td>Q</td><td>B</td></tr><tr><td>G</td><td>E</td><td>R</td><td>N</td></tr><tr><td>H</td><td>C</td><td>S</td><td>L, M</td></tr><tr><td>I</td><td>C, F</td><td>T</td><td>S</td></tr><tr><td>J</td><td>G, H, I</td><td>U</td><td>P, Q</td></tr><tr><td>K</td><td>J</td><td>V</td><td>U</td></tr></table> |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                       | Activity | Immediate Predecessor | Activity | Immediate Predecessor | A | - | L | K | B | A | M | K | C | B | N | K | D | C | O | D | E | D | P | O | F | E | Q | B | G | E | R | N | H | C | S | L, M | I | C, F | T | S | J | G, H, I | U | P, Q | K | J | V | U |
| Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Immediate Predecessor                                                                                                                                                                                                                                                                                                                                                                                                                                | Activity | Immediate Predecessor |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                                                                                                                                                                                                                                                                                                                                                                                                                                    | L        | K                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A                                                                                                                                                                                                                                                                                                                                                                                                                                                    | M        | K                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | B                                                                                                                                                                                                                                                                                                                                                                                                                                                    | N        | K                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | C                                                                                                                                                                                                                                                                                                                                                                                                                                                    | O        | D                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | D                                                                                                                                                                                                                                                                                                                                                                                                                                                    | P        | O                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | E                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Q        | B                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | E                                                                                                                                                                                                                                                                                                                                                                                                                                                    | R        | N                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | C                                                                                                                                                                                                                                                                                                                                                                                                                                                    | S        | L, M                  |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | C, F                                                                                                                                                                                                                                                                                                                                                                                                                                                 | T        | S                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| J                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | G, H, I                                                                                                                                                                                                                                                                                                                                                                                                                                              | U        | P, Q                  |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |
| K                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | J                                                                                                                                                                                                                                                                                                                                                                                                                                                    | V        | U                     |          |                       |          |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |      |   |   |   |         |   |      |   |   |   |   |

|      |                                                                                                                                                                                                                        |    |
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| Q.7B | Use the simplex method to solve the following system of linear equations:<br>$\begin{aligned} x_1 - x_3 + 4x_4 &= 3, \\ 2x_1 - x_2 &= 3, \\ 3x_1 + 2x_2 - x_4 &= 1, \\ x_1, x_2, x_3, x_4 &\geq 0. \end{aligned}$      | 15 |
|      | OR                                                                                                                                                                                                                     |    |
| Q.7B | Maximize $Z = 10x_1 + 6x_2 + 11x_3$ ,<br>Subjected to $\begin{aligned} 4x_1 + 6x_2 + 7x_3 &\leq 210, \\ 9x_1 + x_2 + 5x_3 &\leq 190, \\ 13x_2 + 2x_3 &\leq 175, \\ x_1 \geq 0, x_2 \geq 0, x_3 &\geq 1. \end{aligned}$ | 15 |