UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Semester: VI
Program: B.Tech. Mechanical   **Time   : 03 hrs.**
Course Code: Work Study & Ergonomics (MEPD 3008)   **Max. Marks: 100**

Instructions: All the questions are compulsory and assume any missing data.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	According to the rules concerning to human body, there should be (a) Definite fixed and accessible place of tools (b) Both the hands should be engaged in the productive work (c) Gravity should be preferred to deliver the assembled parts (d) Multi purse tools should be used	4	CO1
Q 2	Consider an output standard of 20 pieces per day with a wage rate of Rs 40 Per hour under 8 hour a day, calculate guaranteed wage rate. (a) 320 (b) 360 (c) 380 (d) 300	4	CO2
Q 3	Emerson's efficiency plan, the efficiency of a worker is calculated as (a) Output time x 100/actual time taken by worker to complete job (b) Standard time x 100/actual time taken by worker to complete job (c) Standard time x 50/Actual time taken by worker to complete job (d) None of these	4	CO2
Q 4	An Incentive scheme should provide (a) Improvements in utilization of tools and plant (b) Recognition to a worker for good contribution (c) Improve relations between workers and management (d) All of the above	4	CO2
Q 5	A milk powder tin is being weighed as it is filled is an example of (a) Operation cum transportation (b) Operation cum inspection (c) Transportation cum inspection (d) None of the above	4	CO1

<table>
<tr><td colspan="4" align="center">SECTION B
(4Qx10M= 40 Marks)</td></tr>
<tr>
<td>Q 6</td>
<td>The following are the particulars applicable to a process:
Time Rate — Rs. 8 per hour, High Task — 200 units per week.
In a 40 hour week, the production of the workers was:
A — 180 units; B — 200 units; C — 205 units.
Calculate the total earnings of the workers under Gantt's Task Bonus system
<div align="center">OR</div>
The following particulars apply to a particular job: Standard production per hour 6 units Normal rate per hour Rs.1.20 Mohan produced 32 units Ram produces 42 units Prasad produces 50 units Calculate the wages of these workers under Merrick Differential Piece Rate System</td>
<td>10</td>
<td>CO3</td>
</tr>
<tr>
<td>Q 7</td>
<td>A metal component is required to be produced in a large number (approximately 1000/day). Two successive milling operations are required which are done on milling machines with automatic feed. The operator need not attend to the machine during the machining operation of the cycle. The operating characteristic of the two operations are as given below:

<table>
<tr><th></th><th>Operation1</th><th>Operation2</th></tr>
<tr><td>Unload</td><td>.12 minute</td><td>.11 minute</td></tr>
<tr><td>Load</td><td>.19 minute</td><td>.15 minute</td></tr>
<tr><td>mill</td><td>.38 minute</td><td>.45 minute</td></tr>
</table>

On the average these machines are working approximately 75 % of the 8 Hr working a day. What arrangement of men and machines would you recommend? Support your answer with suitable multiple activity chart. You may assume any convenient arrangement of machines.</td>
<td>10</td>
<td>CO2</td>
</tr>
<tr>
<td>Q 8</td>
<td>A researcher is engaged in collecting physiological data of 3 subjects (A,B,C) in Ergonomics laboratory. The data w.r.t. setting time, recording time and unloading time is given in the table below. Make a multiple activity chart so that all the four workers are checked on each machine. Calculate the idle time for the researcher and 3 machines and waiting time for each subject.

<table>
<tr><td>Name of test on machine</td><td>HRV</td><td>BERA</td><td>BP</td></tr>
<tr><td>Setting time (min)</td><td>5</td><td>7</td><td>2</td></tr>
<tr><td>M/C Running Time (Min)</td><td>15+5=20</td><td>3+3=6</td><td>2</td></tr>
<tr><td>Un loading time (Min)</td><td>3</td><td>3</td><td>1</td></tr>
</table></td>
<td>10</td>
<td>CO2</td>
</tr>
<tr>
<td>Q 9</td>
<td>A work study engineer conducted stopwatch time study on a job for taking the observations the job was divided into 5 elements. The observations made on 4 cycles (in minutes) of all the 5 elements are shown in the table given below. Calculate the</td>
<td>10</td>
<td>CO3</td>
</tr>
</table>

normal time and standard time for the job. If relaxation allowances of 12 %, contingency allowance if 3% and incentive of 20 % are applicable for the job.

Element	Time (minutes) for Cycle				Performance Ratting
	1	2	3	4	
1	1.246	1.328	1.298	1.306	90
2	0.972	0.895	0.798	0.919	100
3	0.914	1.875	1.964	1.972	100
4	2.121	2.198	2.146	2.421	110
5	1.253	1.175	1.413	2.218	100

SECTION-C
(2Qx20M=40 Marks)

Q 10 A stop watch time study has been made of an operation which consist of four elements. The table below gives the continuous time readings (in centiminutes), ratings and allowances for the elements. Determine

i. Basic time and standard time for each element.
ii. Standard of operation.
iii. Whether the number of operations are sufficient for each element if the desired confidence level is 90% and accuracy required is ± 5%.

Element	1	2	3	4
Observation	Continuous stop watch readings (Centimin.)			
1	9	15	28	32
2	40	46	59	62
3	71	80	94	97
4	106	113	127	130
5	138	143	156	159
6	167	172	184	188
7	198	203	218	221
8	228	233	246	249
9	257	262	275	279
10	288	293	306	309
Avg. Rating (%)	105	110	100	90
Allowance (%)	15	10	20	25

20 **CO4**

Q 11 Prepare a material type proces flow chart for the following activity.

20 **CO4**

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                              ACTIVITY                              TYPE OF ACTIVITY
        DISTANCE
          (m)      In old-engine stores . . . . . . . . . . . . . .
                   Picked up engine by crane (electric) . . . . . . .    Non-productive
                   Transported to next crane . . . . . . . . . . . .
          24       Unloaded to floor . . . . . . . . . . . . . . . .          ..
                   Picked up by second crane (electric) . . . . . . .         ..
                   Transported to stripping bay . . . . . . . . . . .         ..
          30       Unloaded to floor . . . . . . . . . . . . . . . .          ..
                   Engine stripped . . . . . . . . . . . . . . . . .    Productive
                   Main components cleaned and laid out . . . . . . .         ..
                   Components inspected for wear; inspection report written .  Non-productive
                   Parts carried to degreasing basket . . . . . . . .         ..
          3        Loaded for degreasing by hand-operated crane . . .         ..
          1.5      Transported to degreaser . . . . . . . . . . . . .         ..
                   Unloaded into degreaser . . . . . . . . . . . . .          ..
                   Degreased . . . . . . . . . . . . . . . . . . . .    Productive
                   Lifted out of degreaser by crane . . . . . . . . .   Non-productive
          6        Transported away from degreaser . . . . . . . . .          ..
                   Unloaded to ground . . . . . . . . . . . . . . .           ..
                   To cool . . . . . . . . . . . . . . . . . . . . .          ..
          12       Transported to cleaning benches . . . . . . . . .          ..
                   All parts completely cleaned . . . . . . . . . . .   Productive
          9        All cleaned parts placed in one box . . . . . . . .  Non-productive
                   Awaiting transport . . . . . . . . . . . . . . .           ..
                   All parts except cylinder block and heads loaded on trolley ..
          76       Transported to engine inspection section . . . . .         ..
                   Parts unloaded and arranged on inspection table . . .      ..
                   Cylinder block and head loaded on trolley . . . . .        ..
          76       Transported to engine inspection section . . . . .         ..
                   Unloaded on ground . . . . . . . . . . . . . . .           ..
         ─────
         237.5     Stored temporarily awaiting inspection . . . . . .         ..
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OR

A hotel manager wishes to find out the best way to toast three slices of bread. He has an old fashioned hand operated electric toaster. It can toast one side of two piece of bread at the same time, but it takes two hands to insert or remove each slice of bread. To turn a slice of bread to toast the other side, the operator has to push the toaster door down and permit a spring to shut it back; this operation requires only one hand. Therefore two pieces of bread can be turned at the same time.

The following are the elemental time needed to perform the operations:
Toasting (One side) = .50 min, Turning of toast = .02 min, Toasting (other side) = .50 min
Insertion time = .05 min, Removing time = .05 min

Assume that both hands can perform their tasks with the same degree of efficiency; draw :

(a) A man-machine chart of this operation.

(b) Another chart showing the improvement in the method suggested by you.