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| **Scheme of Valuation/Answer Key**(Scheme of evaluation (marks in brackets) and answers of problems/key) |
| **Course Code: ME376** |
| **Course Name: Maintenance Engineering** |
| Max. Marks: 100 |  | Duration: 3 Hours |
| **PART A** |
|  |  | ***Answer any three full questions, each carries 10marks.*** | Marks |
| 1 | a) | Definition of maintenance (2 marks) &Discussion on steps/principles of maintenance that can be done on a two-wheeler on regular basis (3 marks)  | (5)  |
|  | b) | Definition of **any two** of the following: Availability, Operational Availability, Achieved Availability, InherentAvailability, Steady state Availability, Mean Availability (2.5 marks each) | (5) |
| 2 | a) | * Series configuration: Figure (1 mark) + Explanation (1.5 mark) + equation of system reliability (1 mark)
* Parallel configuration: Figure (1 mark) + Explanation (1.5 mark) + equation of system reliability (1 mark)
 | (7) |
|  | b) | Direct Substitution in formula:System reliability, Rs= R1x R2x ….. x Rn= 0.19278 | (3)  |
| 3 |  | Definition + Principles + Objectives + steps of corrective maintenance.Corrective maintenance may be classified into five major categories as shown in Fig. These are: fail-repair, salvage, rebuild, overhaul, and servicing. *1*These categories are described below.1. Fail-repair:The failed item is restored to its operational state.2. Salvage:This element of corrective maintenance is concerned with disposal of non-repairable material and use of salvaged material from non-repairable equipment/item in the repair, overhaul, or rebuild programs.3. Rebuild:This is concerned with restoring an item to a standard as close as possible to original state in performance, life expectancy, and appearance. This is achieved through complete disassembly, examination of all components, repair and replacement of worn/unserviceable parts as per original specifications and manufacturing tolerances, and reassembly and testing to original production guidelines.4. Overhaul:Restoring an item to its total serviceable state as per maintenance serviceability standards, using the “inspect and repair only as appropriate” approach.5. Servicing:Servicing may be needed because of the corrective maintenance action, for example, engine repair can lead to crankcase refill, welding on, etc. Another example could be that the replacement of an air bottle may require system recharging. | (10)  |
| 4 | a) | Explanation of thermography (3 marks) + an example/case study of application of thermography (2 marks). | (5) |
|  | b) | Definition of :Odour Management Plan.Purpose and/or applications and/or examples and/or techniques of odour monitoring. (grace marks of 2 can be given) | (5)  |
| **PART B** |
| ***Answer any three full questions, each carries 10marks.*** |
| 5 |  | Explanation of crack monitoring (2 marks) + explanation of **any 4** of following methods of crack monitoring: Liquid Penetrant testing, Magnetic flux testing, Electrical Resistance Testing, Eddy Current Testing, Radiography testing, Ultrasonic testing (2 marks each) | (10 )  |
| 6 |  | Explanation of Four steps in spectrometric ananlysis. (2.5 marks each) | (10) |
| 7 | a) | Explanation of **any 4** Principles of RCM with any example. | (7) |
|  | b) | Classification of failure - explanation – catastrophic failure and gradual failure | (3) |
| 8 |  | Brief explanation about FMEA(Failure Modes and Effects Analysis)- 4 MarksSteps involved in FMEA - 6 Marks | (10 )  |
| **PART C** |
| ***Answer any fourfull questions, each carries 10marks.*** |
| 9 | a) | Discussion of pillars of 5S.**SEIRI - Sort out:** This means sorting and organizing the items as critical, important, frequently used items, useless, or items that are not need as of now. Unwanted items can be salvaged. Critical items should be kept for use nearby and items that are not be used in near future, should be stored in some place. *For this step, the worth of the item should be decided based on utility and not cost*. As a result of this step, the search time is reduced.**SEITON - Organise:** The concept here is that "*Each items has a place, and only one place*". The items should be placed back after usage at the same place. To identify items easily, name plates and coloured tags has to be used. Vertical racks can be used for this purpose, and heavy items occupy the bottom position in the racks. **SEISO - Shine the workplace:** This involves cleaning the work place free of burrs, grease, oil, waste, scrap etc. No loosely hanging wires or oil leakage from machines. **SEIKETSU - Standardization:** Employees has to discuss together and decide on standards for keeping the work place / Machines / pathways neat and clean. This standards are implemented for whole organization and are tested / Inspected randomly. **SHITSUKE - Self discipline:** Considering 5S as a way of life and bring about self-discipline among the employees of the organization. This includes wearing badges, following work procedures, punctuality, dedication to the organization etc. | (10) |
|  | b) | TPM Targets are |
| 10 | a) | Explanation of the Concept of Business Centered Maintenance. | (5)  |
|  | b) | Overall equipment effectiveness explanation OEE = Fully Productive time/ Planned production time. | (5)  |
| 11 | a) |  Define and explain terotechnology. | (5)  |
|  | b) | Explanation of use of c-chart in quality control. | (5)  |
| 12 |  | Classification of maintenance budget – Revenue based (appropriation, fixed and flexible budget) and capital budget (4 marks)Steps in preparing maintenance budget (6 marks) | (10)  |
| 13 |  | Definition of CMMS (2.5 marks), Functions (2.5 marks), Applications (2.5 marks) & Advantages (2.5 marks) | (10)  |
| 14 |  | Classification of maintenance costs – fixed & variable cost, Direct & Indirect costs, Revenue & capital costs (explained with an example) | (10) |
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