

SCHEME OF EVALUATION

(Scoring indicators)

QUESTION WISE ANALYSIS

Course: 6026 MAINTENANCE ENGINEERING

Version: 2015 REVISION

Qn No:	Specific outcome (as per syllabus)	Module	Content details	score	score	Time in minutes
I)1	Principles of reliability	ii	Basic concept of reliability	2	10	Part A 2X5=10
2	Describe the condition monitoring	i	Condition monitoring	2		
3	Determine the failure rate	ii	Failure rate	2		
4	To understand repair cycle	iii	Repair cycle	2		
5	Determine the time between failures	ii	Study of MTTR	2		
II 1	Compare the merits of maintenance category	I	Maintenance categories	6	30	Part B 5X6=30
II 2	Determine failure rates	ii	Failure rates	6		
II 3	To understand Principles of lubrication	I	Principles of lubrication	6		
II 4	Illustrate vibration signature	iii	Vibration signature analysis	6		
II 5	To understand wear debris analysis	IV	Wear debris analysis	6		
II 6	Principle of maintenance activity	I	Breakdown maintenance	6		
II 7	Explain the repair method of M.H.E	IV	Repair methods for M.H.E	6		
III a	To understand sound maintenance system	I	Importance & benefits of sound maintenance system	7	15	PART C 15x4=60
III b	To understand maintenance schedule	I	Maintenance schedule	8		
IVa	Study about breakdown maintenance	I	Break down maintenance	7		
IVb	To understand types of lubrication	I	Principles of lubrication	8		
V a	To understand bath tub curve	II	Bathtub curve	7	15	
Vb	To understand concept of reliability & availability	II	Factors of availability & reliability	8		
VIa	Determine mean time between failures	II	Determine MTBF, MTTR	7		
VIb	Study on Cost comparison	II	Cost comparison	8		
VIIa	Instruments for C.M	III	Pistol thermometer	7	15	
VIIb	Vibration measurement	III	Vibration signature analysis	8		
VIIIa	To study Vibration monitoring	III	Vibration analysis	7		
VIIIb	Identify the methods of C M	III	Condition monitoring causes	8		
IX a	Identify the use of computer in maintenance	IV	Use of computer in maintenance	7	15	
IX b	Identify repair methods of gears	IV	Repair methods for gears	8		
Xa	Describe N.D.T methods	IV	LIQUID PENETRANT test	7		
X b	Identify the technique regarding corrosion monitoring	IV	Corrosion monitoring	8		
		total			100	100

SCHEME OF EVALUATION

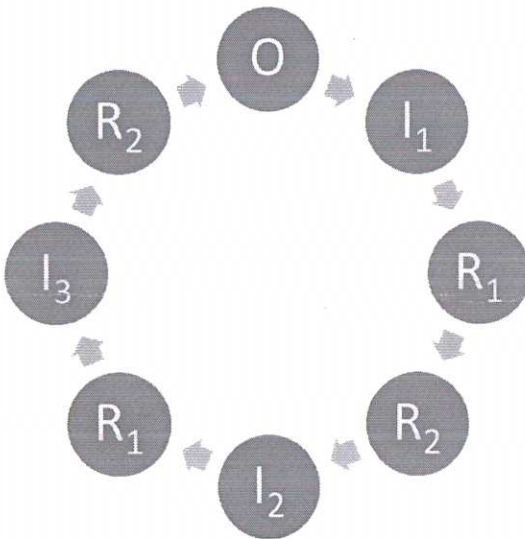
(SCORING INDICATORS)

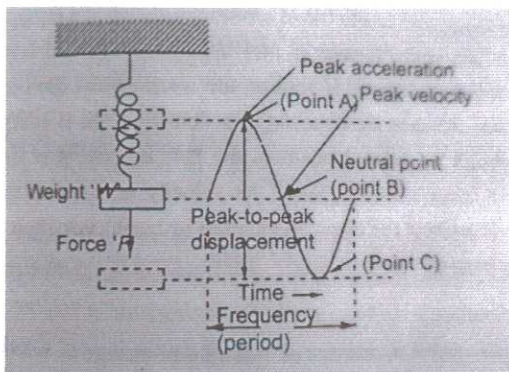
TED (10) -6026 MAINTENANCE ENGINEERING

(REVISION 2015)

Q NO	Scoring indicators	Split score	Total score
PART A			
I. 1	Reliability is defined as the probability that a component/system, when operating under given condition will perform its intended functions adequately for a specified period of time.	2	2
2	Condition monitoring (CM) is one of the maintenance methods which are used to access the health and condition of the equipments, machines, systems or process by absorbing, checking, measuring and monitoring several parameters.	2	2
3	a) workman ship b) Improper design c) Manufacturing defects d) Incorrect usage of equipment	2	2
4	It is a kind of maintenance schedule generally involves inspection, repair (minor and major) and overhauling which are repeatedly carried out in sequence.	2	2
5	Mean Time To Repair (MTTR) is the arithmetic mean of the time required to perform maintenance action, MTTR is defined as the ratio of Total maintenance time and no. of maintenance system	2	2
PART B			
II 1	<pre> graph TD Maintenance[Maintenance] --> Planned[Planned maintenance] Maintenance --> Unplanned[Unplanned maintenance] Planned --> Preventive[Preventive maintenance] Planned --> Corrective[Corrective maintenance] Planned --> Predictive[Predictive maintenance] Preventive --> Running[Running maintenance] Preventive --> Shutdown1[Shutdown maintenance] Preventive --> Scheduled[Scheduled maintenance] Corrective --> Shutdown2[Shutdown maintenance] Corrective --> Breakdown[Breakdown maintenance] </pre>	6	6
II 2	Failure – causes of failure(design, process, experience, service), nature of failure (catastrophic, creep, independent). Phases of failure(Bath Tub	2X3=6	6

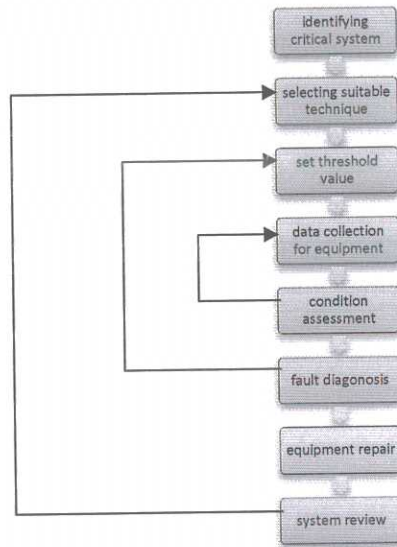
II 3	<p>curve)</p> <p>i.Reduce friction ii.reduce wear & tear iii. dissipation of heat iv. cost reduction of maintenance v. reduce oxidation & rust formation vi. provide insulation in transformer application vii. seal against dust,dirt,water etc. (any six, 6x1=6)</p>	6x1=6	6
II 4	<p>Vibration analysis is a very effective method of detecting machine faults and severity of faults, knowing the frequency of vibration is important. Methods: i.spectral analysis ii.statistical analysis iii.envelop analysis iv.spike energy method v. natural frequency vi. Harmonic forces vi. Transient and impulse forces</p>	3+3=6	6
II 5	<p>Wear debris analysis provide direct information about the wearing condition of the equipment. Study of particle shape, composition, size and quantity helps to know the condition of the machine. 5 basic types of wear can be identified ; rubbing wear, cutting wear, rolling fatigue wear, sliding wear. Methods : i . optical method ii.filter blockage iii. Radio activity iv. magnetic attraction v. wear vi. Radio activity vii. Electrical conductance viii. image analysis</p>	2+4=6	6
II 6	<p>The equipment is allowed to function/operate till no failure occurs. No maintenance work is carried out in advance to prevent failure As long as the equipment is functioning at a minimum acceptable level, it is assumed to be effective. In this category/program, less attention is given to the operating condition of critical machinery, equipment or system. Applicable for small companies.</p>	4+2=6	6
II 7	<p>Inspection – repair – overhaul-Description only</p>	2+2+2=6	6
III a	<p style="text-align: center;">PART C UNIT 1</p> <p>i) Minimization of down time ii) Extended life of equipment iii) Improvement in availability of system iv) Safety and smooth operation of the process v) Provide adequate backup supply vi) Minimizing wear and tear vii) Safety of workers viii) Increased reliability of the system</p>		

	<p>ix) Providing proper working environment</p> <p>x) Profit of the production system. (any 7, 7x1=7)</p>	7x1=7	7
III b	<p>Maintenance scheduling is a joint maintenance operations activity in which maintenance agrees to make the resources available at a specific time when the unit can also be made available by operations. Scheduling necessitates active and positive participation of users of maintenance services and unlike preventive maintenance results in tangible measurable results.</p> <p>i. Inspection (I) ii. Major Repair (R₁) iii. Minor repair (R₂) iv. Overhauling (O)</p> <p>REPAIR CYCLE: Repeated performances of the above mentioned activities in sequence between successive overhauling is termed as repair cycle.</p> <p>O-I₁-R₁-R₂-I₂-R₁-I₃-R₂-O</p>  <p style="text-align: center;">UNIT 2</p>		
IV a	<p>Reactive maintenance, breakdown and emergency maintenance; - maintenance after failure, circumstances- onetime task- steps:</p> <ol style="list-style-type: none"> 1. Collection of data/informations 2. Identification of causes 3. Best possible alternatives to eliminate causes 4. Implementation, difference between corrective and preventive maintenance 	2+2+4	8
IV b	<p>Various methods – name</p> <p>Hydrostatic lubrication-hydrodynamic lubrication. Sketches and comparison</p>	2+4+1	7
		2+6	8

VII a	<p>Pistol thermometer</p> <p>It measures between -30 and +900c to a 0.1c resolution with a very fast response time and a distance to spot ratio of 60:1</p> <p>In pistol thermometers temperature data can be stored, presented graphically, and analyzed , and the photographic images can be displayed on screen for improved documentation and maintenance follow up. It is an ideal professional diagnostic tool for maintenance professionals , which enables to capture time stamped digital photographic image as a temperature reading is taken.</p>	7	7
VII b	 <p>fig.5marks</p> <p>If we plot the movement of weight against time the plot shown in fig will be generated. The motion of the weight from its neutral position to upper limit back through the neutral position to the lower limit and its return to the neutral position,represent one cycle.</p>	5+3	8
VIII a	<p>Mechanical causes of vibrations are:</p> <ol style="list-style-type: none"> 1. Unbalanced rotating components 2. A bent or warped shaft 3. Pump & driver alignment 4. Pipe strain either by design or as a result of thermal growth 5. Mass of pump base is too small 6. Thermal growth of various components- shafts 7. Worn,loose or bad rolling element bearing 8. Loose hold down bolts 9. Some parts rubbing others 10. Product attaching to a rotating components 11. Loose parts or damaged parts 12. Bad gears 13. Improper design of base plate or foundation. 14. Operation at too low a capacity 	14x1/2 =7	7

VIII
b

Processes involved in condition monitoring



7x1=7

7

IX a

Computerized maintenance management system

Objectives:

- 1) Maintenance of existing equipment
- 2) Inspection and service of the equipment
- 3) Installation and revamping of the equipment
- 4) Maintenance storekeeping
- 5) Craft administration

(any four)

Advantages:

- 1) Improved maintenance efficiency
- 2) Reduced maintenance cost
- 3) Reduced overtime and ensures optimal utilization of manpower
- 4) Reduced equipment downtime
- 5) Increased life of equipment
- 6) Quicker access to plant maintenance statistics
- 7) Provides maintenance reports in specific formats depending on the requirements

(any four)

3+4=7

7

V a

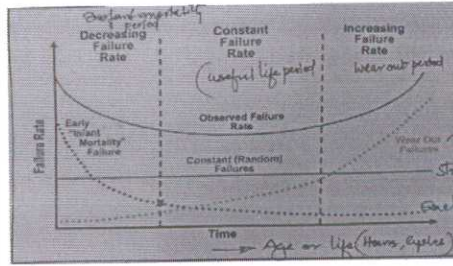


fig.3 marks

Bath tub curve is a representation of the reliability performance of components or non repaired items. It observes the reliability performance of a large sample of homogenous items entering the field at some start time. There are three periods for bath tub curve. The infant mortality or early failure portion, useful life period and wear out period.

3+4

7

V b

Reliability & availability- definition -types

4+4

8

VI a

MTBF mean time between failures is the mean or average time between successive failures of a product. This refers to the average time of breakdown until the device is beyond repair.
 Mean time to repair MTTR is the arithmetic mean of the time required to perform maintenance action It is the ratio of total maintenance time and number of maintenance action.

3+4

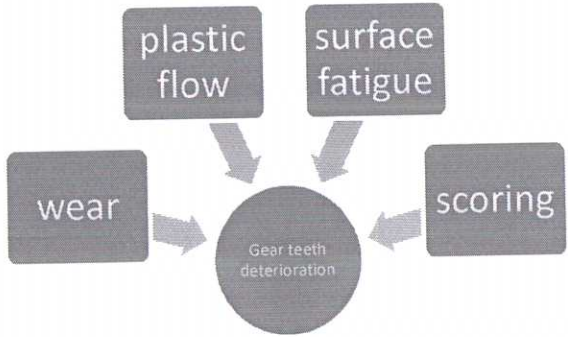
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VI b

- 1) Centralised planning , scheduling and control
- 2) Grouping of specialized workforce
- 3) Effective labor utilization strategies
- 4) Budgetary control and proper check mechanism
- 5) Effective use of contract maintenance systems
- 6) Purchase of reliable equipment and spares
- 7) Use of trained and skilled workforce
- 8) Proper selection of suitable spares and materials
- 9) Proper safety education
- 10) Constant appraisal in the area of maintenance (Any eight)

8x1

8

IX b	 <p data-bbox="284 689 762 728">Causes of gear teeth surface deterioration</p>	4x2=8	8
X a	<p data-bbox="284 790 526 824">Liquid penetrant test</p> <p data-bbox="284 813 1181 1055">Liquid penetrant test is one of the oldest methods of non destructive testing. It is based on the old oil and whiting process , formerly widely employed on steel parts, particularly in the rail road industry. The oil and whiting method consisting of applying a dirty penetrating oil to the test surface, wiping the oil from the surface after a few minutes, and then coating parts with an alcohol-chalk suspension solution. Where cracks existed, the dirty oil seeped through the white coating, thus indicating the presence of discontinuities.</p> <p data-bbox="284 1043 1181 1122">Liquid penetrant inspection detects only those discontinuities that are present on or are open to the surface of the part.</p> <p data-bbox="284 1111 1181 1155">Therefore liquid penetrant test process are carried out for surface defects only.</p> <p data-bbox="384 1155 504 1189">Procedure</p> <p data-bbox="384 1189 536 1223">Applications</p>	3+3+1 =7	7
X b	<p data-bbox="284 1305 1181 1417">The principles of corrosion monitoring equipment are based on corrosion or chemical wear of the material. The use of such technique for condition monitoring of machines /components is very limited and selective.</p> <p data-bbox="284 1406 1181 1485">The monitoring procedure for the chemical wear of the equipment due to the corrosion effect is done in corrosion monitoring, using special arrangements.</p> <p data-bbox="284 1485 611 1518">Monitoring techniques are:</p> <ol data-bbox="284 1518 845 1686" style="list-style-type: none"> a) Weight loss method b) Electrical resistance method c) Linear polarization resistance LPR method d) Corrosion potential measurement e) Sentinel hole method <p data-bbox="954 1641 1069 1675">(any two)</p>	8	8

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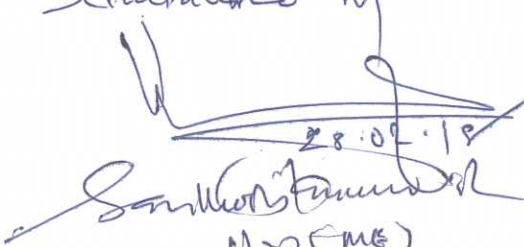
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Sl No	Module	Part A		Part B		Part C		Total	
		No: of questions	score	No: of questions	score	No: of questions	score	No: of questions	score
1	I	1	2	3	18	2	15	5	29
2	II	2	4	1	6	2	15	5	29
3	III	1	2	2	12	2	15	6	31
4	IV	1	2	1	6	2	15	4	23
	Total	5	10	7	42	8	60	20	112

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Scrutinized by

28.02.18
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