Examinations Commencing from 23rd December 2020 to 6th January 2021
Program: **Mechanical Engineering**
Curriculum Scheme: Rev2016
Examination: TE Semester VI
Course Code: MEC604 and Course Name: Refrigeration and Air Conditioning

Time: 2 hour   Max. Marks: 80

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Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	When food products or other hygroscopic materials kept in different compartments are to be maintained at different temperature, then the evaporator:
Option A:	at the same temperature with single compressor is used.
Option B:	at different temperatures with single compressor is used.
Option C:	at different temperatures with individual compressor is used.
Option D:	at the same temperature with individual compressor is used.
2.	For a VCRs with superheated vapour after compression having enthalpy 206kJ/kg and enthalpy of 185kJ/kg before compression, determine the mass flow rate of the refrigerant, if the power required to drive the compressor is 6.4kW.
Option A:	18.26kg/min
Option B:	2.24kg/min
Option C:	0.304kg/min
Option D:	1.86kg/min
3.	There is change of phase of refrigerant in
Option A:	Gas refrigeration
Option B:	Vortex-tube refrigeration
Option C:	Vapor absorption Refrigeration
Option D:	Natural refrigeration
4.	The sensible heat factor for auditorium or cinema hall is generally kept as
Option A:	0.6
Option B:	0.8
Option C:	0.7
Option D:	0.9
5.	Which of these factors governs the capacity of cooling tower?
Option A:	The dew point temperature of air.
Option B:	The length of exposure time.
Option C:	The material by which the cooling tower is made.
Option D:	Density of air
6.	What is the value of m,n,p,q of R-124 as per designation system for Refrigerants
Option A:	2,1,0,4
Option B:	2,1,1,4
Option C:	2,1,1,3

Option D:	2,1,4,1
7.	Air refrigerator works on
Option A:	Otto cycle
Option B:	Bell Coleman cycle
Option C:	Reversed Rankine cycle
Option D:	Brayton cycle
8.	Electrolux refrigerator has
Option A:	only one liquid pump
Option B:	only two liquid pumps
Option C:	no liquid pump
Option D:	three liquid pumps
9.	Which one of the following is correct? On Psychrometric chart, the constant wet bulb temperature lines coincide with.
Option A:	constant relative humidity lines
Option B:	constant enthalpy lines
Option C:	constant dew point temperature lines
Option D:	constant volume lines
10.	During a refrigeration cycle heat is rejected by the refrigerant in a
Option A:	Compressor
Option B:	Condenser
Option C:	Evaporator
Option D:	expansion valve
11.	If the COP of 1 TR ammonia water refrigeration plant is 0.5, then the heat supplied in the generator is
Option A:	1.5kw
Option B:	3.5kw
Option C:	7kw
Option D:	10kw
12.	The method generally used on large scale to protect milk against bacterial infection is
Option A:	Heat processing
Option B:	Dehydration
Option C:	Canning
Option D:	Pasteurization
13.	The conditioned air supplied to the room must have the capacity to take up
Option A:	room sensible heat load
Option B:	room latent heat load
Option C:	sum of room sensible and latent heat load
Option D:	difference of room sensible and latent heat load
14.	What is the saturation temperature at the partial pressure of water vapour in the air-water vapour mixture called?
Option A:	Dry bulb temperature

Option B:	Web bulb temperature
Option C:	Dew point temperature
Option D:	Saturation temperature
15.	Efficiency of heating/cooling coil is given as
Option A:	1-BPF
Option B:	1/BPF
Option C:	1+BPF
Option D:	1^BPF
16.	Which refrigerant is not recommended in marine air conditioning due to its oil miscibility?
Option A:	NH3
Option B:	R-11
Option C:	R-22
Option D:	R-12
17.	The slope of the room sensible heat factor (RSHF) line is the ratio of
Option A:	Room Latent Heat/ Room Sensible Heat
Option B:	Room Sensible Heat/ Room Total Heat
Option C:	Room Sensible Heat/ Room Latent Heat
Option D:	Room Latent Heat/ Room Total Heat
18.	On extending the GSHF line upto the saturation curve, it gives
Option A:	DBT
Option B:	WBT
Option C:	RH
Option D:	ADP
19.	Freon group of refrigerants are
Option A:	Inflammable
Option B:	Toxic
Option C:	Non-inflammable and toxic
Option D:	Nontoxic and non-inflammable
20.	Room air conditioners and packaged units are examples of _____
Option A:	Direct expansion systems
Option B:	Chilled water systems
Option C:	Indirect contraction system
Option D:	Indirect expansion systems

Q2	**Solve any Four out of Six** **5 marks each**
A	Draw schematic and T-s diagram of simple air refrigeration system.
B	Explain Li-Br refrigeration system.

C	Define:
	    i) Dry bulb Temperature
	    ii) Wet bulb Temperature
	    iii) Dew point Temperature

	iv) Wet bulb depression v) Dew point depression	
D	Distinguish between natural cooling tower and mechanical cooling tower.	
E	Explain Winter Air Conditioning system.	
F	Explain Montreal protocol.	

Q3.	**Solve any Two Questions out of Three 10 marks each**
A	Draw and explain the Actual Vapour Compression Refrigeration cycle.
B	A refrigeration machine using R-12 as refrigerant operates between the pressures 2.5 bar and 9 bar. The compression is isentropic with no undercooling in the condenser. The vapour is in dry saturated at the beginning of the compression. Estimate the theoretical COP. If the actual COP is 0.65 of theoretical value, calculate the net cooling produced per hour. The refrigerant flow is 5 kg per minute. Refer the Refrigerants properties data book for the Properties of refrigerant.
C	On a particular day, the atmospheric air was found to have a DBT of 30°C and a WBT of 18°C. The barometric pressure was observed to be 756mm of Hg. Using the tables of psychrometric properties of air, determine the relative humidity, the specific humidity, the dew point temperature, the enthalpy of air per kg of dry air and the volume of mixture per kg of dry air.

Examinations Commencing from 23rd December 2020 to 6th January 2021
Program: BE Mechanical Engineering
Curriculum Scheme: Rev2016
Examination: Third Year Semester VI
Course Code: MEDLO6021and Course Name: Mechatronics

Time: 2hour   Max. Marks: 80

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Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	PLC is
Option A:	Analog electronic device
Option B:	Digital electronic device
Option C:	Digital mechanical device
Option D:	Analog mechanical device
2.	The capacity of conventional relay systems for compound operations is _____ that of the PLCs
Option A:	poor than
Option B:	excellent than
Option C:	as good as
Option D:	unpredictable as
3.	An AND function implemented in ladder logic uses:
Option A:	Normally-closed contacts in series
Option B:	Normally-open contacts in series
Option C:	Normally-closed contacts in parallel
Option D:	Normally-open contacts in parallel
4.	When the number of zeroes is equal to the number of poles, how many branches of root locus tends towards infinity?
Option A:	3
Option B:	2
Option C:	0
Option D:	Equal to number of poles
5.	For a stable closed loop system, the gain at phase crossover frequency should always be
Option A:	less than20 dB
Option B:	less than 6 dB
Option C:	more than 6 dB
Option D:	more than 0 dB
6.	In a bode magnitude plot, which one of the following slopes would be exhibited at high frequencies by a 4th order all-pole system
Option A:	- 80dB/decade
Option B:	- 40 dB/decade

Option C:	20 dB/decade
Option D:	60 dB/decade
7.	Which is the best example of a single channel data acquisition system?
Option A:	APM
Option B:	BPM
Option C:	CPM
Option D:	DPM
8.	Which of the scientific principle makes hydraulic systems feasible ?
Option A:	Pascal's principle
Option B:	Boyle's law
Option C:	Bernoulli's principle
Option D:	The fluid flow principle
9.	What does the numbers in 4/2 valve mean
Option A:	4 positions and 2 ports
Option B:	4 ports and 2 positions
Option C:	4 positions and 4 ports
Option D:	2 ports and 2 positions
10.	In pneumatic systems, AND gate is used for
Option A:	Check Valve
Option B:	Shuttle Valve
Option C:	Dual Pressure Valve
Option D:	Gate Valve
11.	Micro-controllers are _____ than the PLCs.
Option A:	Bulky And Expensive
Option B:	Bulky But Cheaper
Option C:	Cheaper And Portable
Option D:	Portable But Expensive
12.	In the real world, Data acquisition of all the physical quantities is done in
Option A:	Random mode
Option B:	Digital mode
Option C:	Analog mode
Option D:	Either analog mode or digital mode
13.	The capacity of data acquisition system (DAQ) can be specified in terms of number of
Option A:	Control Elements
Option B:	Channels
Option C:	Interfaces
Option D:	Functions
14.	Inductive proximity sensors can be effective only when the objects are of _____ materials
Option A:	Ferro magnetic
Option B:	Diamagnetic

Option C:	Para magnetic
Option D:	Trimagnetic
15.	A piezo-electrical crystal generates voltage when subjected to following type of force
Option A:	Electrical
Option B:	Mechanical
Option C:	Gravity
Option D:	Fluid
16.	Following acts as detector in Optical sensor
Option A:	Light emitting diode
Option B:	Photo diode
Option C:	Transistor
Option D:	Amplifier
17.	The mechatronics is an integrative field in which the disciplines those act together are
Option A:	Mechanical and Electronic systems
Option B:	Mechanical , Electronic systems and Information technology
Option C:	Electronic systems and Information technology
Option D:	Mechanical and Information technology
18.	Which of the following is not advantage of Mechatronics system?
Option A:	Products are of good quality
Option B:	High degree of flexibility
Option C:	Greater extent of machine utilization
Option D:	Initial cost
19.	The function of actuator is to
Option A:	Produce motion or cause some action
Option B:	Detect the state of system parameters
Option C:	Control the system
Option D:	Provide visual feedback to users.
20.	Ratio of Laplace transformation of controlled output to reference input is known as
Option A:	Transfer function
Option B:	Closed loop system
Option C:	Open loop system
Option D:	Block diagram

Q2	**Solve any Two Questions out of Three 20 marks**

A	Determine the transfer function of the mechatronic system shown in figure
B	Illustrate working of Stepper Motor. State Stepper Motor performance characteristics.
C	Illustrate working of different signal filters.

Q3	Solve any Two Questions out of Three 20 marks
A	Two double acting pneumatic cylinders A and B are selected for an industrial application. The sequence of movement for piston of the cylinder is proposed as below. (AB)+ Delay(5sec) B- Delay(5sec) A- Develop the electro-pneumatic circuit using 5/2 double solenoid as final directional control valves. The piston motion mentioned in bracket is simultaneous.
B	Obtain the root locus for a unity feedback system with open loop transfer function. Comment on the stability of the system. $$G(s) = \frac{k}{s(s+4)(s+5)}$$
C	Material A and Material B are collected in a tank. These materials are mixed for a while. Mixed product is then drained out through Outlet valve. • To detect level of Material A and Material B, two separate level switches are used. • To detect low level, one more level switch is used at the bottom of the tank. • This gives output in digital terms that is when corresponding levels are detected. • To control level of this system, Single Acting Piston valve (1 and 2) can be used which has two states, either fully open or fully close. • To control mixing, agitator is used which is connected with Motor shaft. • Particular time delay is used to mix the materials for a 60 sec. • Outlet valve is then operated to drain the mixed product. Develop a ladder logic diagram.

University of Mumbai
Examination 2020 under cluster 9(FAMT)
Program: Mechanical Engineering
Curriculum Scheme: Rev2016
Examination: TE Semester VI
Course Code:MEDLO6022 and Course Name: Robotics

Time: 2 hour   Max. Marks: 80

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Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry two mark each.
1.	Which part of the Robot provides motion to the manipulator and end-effector?
Option A:	Controller
Option B:	Sensor
Option C:	Actuator
Option D:	Links
2.	The rotation matrix about z axis is
Option A:	$\begin{bmatrix} 1 & 1 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$
Option B:	$\begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$
Option C:	$\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$
Option D:	$\begin{bmatrix} 1 & 1 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix}$
3.	Which among the following is not the functionality of Robots
Option A:	Reprogrammability
Option B:	Multifunctinality
Option C:	Efficient Performance
Option D:	Responsibility
4.	According to Denavit-Hartenberg's notations, Joint Angle can have
Option A:	positive value only
Option B:	negative value only
Option C:	zero value only
Option D:	either positive or negative or zero value
5.	According to Denavit-Hartenberg notations, joint angle is defined as the
Option A:	Angle between two Z axes measured about X axis
Option B:	Angle between two X axes measured about Z axis

Option C:	Angle between two Y axes measured about X axis
Option D:	Angle between two X axes measured about Y axis
6.	Motion planning aims to
Option A:	Provide teaching to a robot
Option B:	Control a robot
Option C:	Determine collision free path for the robot
Option D:	Ensure smooth variation of joint angles of a robot
7.	The twist angle for the second frame for 2-DOF serial manipulator shown below, is_____.
Option A:	0 degree
Option B:	90 degree
Option C:	180 degree
Option D:	45 degree
8.	Spot welding and Arc welding are the examples of
Option A:	Point-to-point tasks
Option B:	Continuous path tasks
Option C:	Continuous path task and point-to-point tasks, respectively
Option D:	Point-to-point and continuous path tasks, respectively
9.	In which of the following operations Continuous Path System is used?
Option A:	Pick and Place
Option B:	Loading and Unloading
Option C:	Continuous welding
Option D:	Conveyor
10.	Determine the Nyquist rate of the signal $x(t) = 1 + \cos 2000\pi t + \sin 4000\pi t$.
Option A:	2000 Hz
Option B:	4000 Hz
Option C:	1 Hz
Option D:	6000 Hz
11.	Joint space technique are used for_____.
Option A:	Spline motion
Option B:	Point to point motion
Option C:	Continous motion

Option D:	Hapazard motion
12.	SCARA robot is very suitable in which kind of operation
Option A:	Single Operations
Option B:	Assembly Operations
Option C:	Rotary Operations
Option D:	Translatory Operations
13.	Ability of sensor to reproduce the results for same input is known as_____.
Option A:	Accuracy
Option B:	Precision
Option C:	Resolution
Option D:	Linearity
14.	Which of the following is NOT static characteristics of sensor?
Option A:	Threshold
Option B:	Drift
Option C:	Sensitivity
Option D:	Fidelity
15.	Optical encoder is used to detect_____.
Option A:	Linear displacement
Option B:	Angular displacement
Option C:	Linear speed
Option D:	Angular speed
16.	Any vision system apart from capturing images also perform_____.
Option A:	Image extraction and compression
Option B:	Image processing and image analysis
Option C:	Image capture and compression
Option D:	Image capture and storage
17.	If a rotor pitch of hybrid stepper motor is 36° and step angle is 9°, the number of phases will be_____.
Option A:	4
Option B:	2
Option C:	3
Option D:	6
18.	The difference between the actual-state and the target-state leads to_____.
Option A:	Motive
Option B:	Gaze
Option C:	Balancing
Option D:	Movement
19.	A single-turn rotary potentiometer with a 330° measurement range is used to provide angular-position feedback information for a positioning application. A 5-V DC voltage is applied across the potentiometer leads, and the potentiometer output is connected to a 12-bit A/D convertor with a 5 V range. The

		potentiometer resistance is 50 . Determine the effective resolution of this sensor.
Option A:	1.61°	
Option B:	16.1°	
Option C:	0.161°	
Option D:	161°	
20.		Recognition of known object and pattern is performed using _____.
Option A:	Force sensor	
Option B:	Laser sensor	
Option C:	Vision sensor	
Option D:	Optical sensor	

Q.2	**Solve any Four out of Six, 5 marks each**
Q2. A	*Describe the term Degrees of freedom of planer robot.*
Q2. B	*Find out the D-H parameter for 3-DOF manipulator shown in figure*
Q.2. C	Explain the working principle of servomotor. Why servomotor is preferred in the joint for positioning.
Q.2. D	*Explain degree of maneuverability about Mobile robot*
Q.2. E	*Define the terms sensors and transducers. How Sensors are selected for particular applications?*
Q.2. F	*Explain applications of Humanoids in medical field. Explain the classification of medical robots with examples.*

Q.3	**Solve any Two Questions out of Three, 10 marks each**
A	*Determine the transformation matrix for end point P for a 2-DOF planner manipulator arm as shown in figure*
B	*Design a single polynomial trajectory which starts from the initial position*

		of $\Theta(0)= 10^0$, passes via a point $\Theta(1)= 5^0$, and then stops at final angular position $\Theta(2)=50^0$. The velocity at start and stop are zero.
	C	Explain ten Principles and considerations in material handling systems design

Examinations Commencing from 23rd December 2020 to 6th January 2021
Program: Mechanical Engineering
Curriculum Scheme: Rev2016
Examination: Third Year Semester VI
Course Code: MEDLO6023 and Course Name: Industrial Automation

Time: 2 hour   Max. Marks: 80

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Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Select an Internal Sensor used in Robot
Option A:	Force
Option B:	Torque
Option C:	Touch
Option D:	Acceleration
2.	Which of the following element does not belong to Block diagram?
Option A:	System Gain
Option B:	Summing Point
Option C:	Take off Point
Option D:	Function Block
3.	Which of the following have higher speed of operations
Option A:	Solenoid actuators
Option B:	Pneumatic actuators
Option C:	Hydraulic Actuators
Option D:	Hybrid actuators
4.	In Brushless DC Motor,
Option A:	Rotor has coils and Stator is of permanent magnet.
Option B:	Both stator and Rotor are of permanent magnet.
Option C:	Rotor is of Permanent Magnet and Stator has coil.
Option D:	Both Stator and rotor has coils.
5.	Which one is not a principle of Material Handling?
Option A:	Ergonomic Principle
Option B:	Work Principle
Option C:	Planning Principle
Option D:	Control Principle
6.	_____ storage is a more recent application of an automated storage technology.
Option A:	Vertical Lift
Option B:	Work in Process
Option C:	Computer Control
Option D:	Numeric control

7.	In Mechanization, we normally make use of:
Option A:	Vision Sensor
Option B:	Capacitive Sensor
Option C:	Limit Switches
Option D:	Optical Sensor
8.	Geneva mechanism was invented by:
Option A:	Watch Maker
Option B:	Mechanical engineer
Option C:	Car Mechanic
Option D:	Dentist
9.	A Group of CNC machines is a _____ level of automation
Option A:	Device Level
Option B:	System Level
Option C:	Machine Level
Option D:	Enterprise Level
10.	Which transmission system should be used for Limited space?
Option A:	Gears
Option B:	Belts
Option C:	Chain Drive
Option D:	Pulleys
11.	The failure diagnostics mode is invoked when a …………… occurs.
Option A:	Process
Option B:	Malfunction
Option C:	Completion
Option D:	Smoothness
12.	Which is not the strategy of Automation & Production system?
Option A:	Increased Flexibility
Option B:	Offline Inspection
Option C:	Process Control & Optimization
Option D:	Improved Material Handling & Storage
13.	Which automation is suited for high production quantities
Option A:	Fixed Automation
Option B:	Flexible Automation
Option C:	Programmable Automation
Option D:	Custom Automation
14.	Programmable automations is suited for
Option A:	Mass Production
Option B:	Batch Production
Option C:	Job Production
Option D:	Custom Product

15.	The Robot designed with Polar coordinate systems has
Option A:	Three Linear Movements
Option B:	Three Rotational Movements
Option C:	Two Linear & One Rotational Movement
Option D:	Two Rotational & One Linear Movement
16.	Where this Limited sequence robots are used?
Option A:	Loading/Unloading
Option B:	Welding
Option C:	Pick & Place
Option D:	Spray Painting
17.	Which type of Control system is preferred for spray painting operation using robot?
Option A:	Point to Point
Option B:	Continuous Path
Option C:	Limited Sequence
Option D:	Limited Point to Point
18.	A one-way valve that lets air into the reservoir of a compressor, but doesn't let it out, is a
Option A:	Check valve
Option B:	Receiver valve
Option C:	Control valve
Option D:	Three way valve
19.	A combination of equipment and controls which handles, stores and retrieves materials with precision, accuracy and speed under a defined degree of automation is known as _____.
Option A:	Automated storage and retrieval system
Option B:	Flexible Manufacturing System
Option C:	Automated Guided Vehicle
Option D:	Conveyor system
20.	The _____ converts the compressed air energy into mechanical energy in the form of linear movement in one direction only.
Option A:	Piston cylinders
Option B:	Double acting cylinders
Option C:	Single acting cylinders
Option D:	Hydraulic pumps

Q2	Solve any Two Questions out of Three 10 marks each
A	*Design simple pneumatic circuit for two cylinder operation with following sequence using 4/2 both side pilot operated valve as DCV.* *A+ B+ C+ B- A- DELAY C-* *With user selection option single cycle & Multicycle operation.*
B	Design simple hydraulic circuit for two cylinder operation with following

	sequence using 4/2 both side pilot operated valve as DCV. A+ Delay B+ (AB)- For single cycle operation. Draw displacement time diagram
C	Explain in detail various components of Assembly line automation (part orienting, feed track, part placing & part escapement systems etc.)

Q3.	Solve any four out of six	05 marks each
i.	Explain PLC Architecture in detail	
ii.	Explain Components of FRL Unit	
iii.	write short note on servo mechanism	
iv.	Write short note on USA automation strategy	
v.	Explain any two Technologies used in AGVs in detail.	
vi.	List & Discuss reasons of automation	

Examination 2020 under cluster 9 (FAMT)
Examinations Commencing from 23rd December 2020 to 6th January 2021
Program: **Mechanical** Engineering
Curriculum Scheme: **Rev2016**
Examination: **TE** Semester **VI**
Course Code: **MEC601** and Course Name: **Metrology and Quality Engineering**

Time: 2-hour   Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	The purpose of instruments is to
Option A:	allow measurements to be made
Option B:	transmit the information
Option C:	change signals
Option D:	Receive the information
2.	Which instrument can not be used for Nanometrology
Option A:	Optical microscope
Option B:	SEM
Option C:	STM
Option D:	TEM
3.	While measuring the diameter of a shaft you notice a positive error of 0.08 mm and the reading obtained from vernier calliper after measuring the diameter of a shaft is 12.40 mm, then what is the final measurement??
Option A:	12.32 mm
Option B:	11.66 mm
Option C:	12.10 mm
Option D:	12.00 mm
4.	Which of the following is not an end standard?
Option A:	Precision scale
Option B:	Length bars
Option C:	Slip gauges
Option D:	Gap gauges
5.	Which of the following is a comparator?
Option A:	Dial Indicator
Option B:	Micrometer
Option C:	Weighing Balance
Option D:	Slip gauges
6.	While designing the Go- and NO-GO gauge for which allowance is provided only on GO gauge?
Option A:	Positive allowance
Option B:	Wear allowance
Option C:	Negative Allowance

Option D:	Special Allowance
7.	10-point heights of irregularities mean
Option A:	Average difference between 10 highest peaks
Option B:	Average difference between 10 highest peaks and 10 deepest valleys
Option C:	Average difference between 10 deepest valleys
Option D:	Average difference between 5 highest peaks and 5 deepest valleys
8.	Johansson Mikrokator is a
Option A:	Optical comparator
Option B:	Electrical comparator
Option C:	Pneumatic comparator
Option D:	Mechanical Comparator
9.	Snap Gauge is used for checking
Option A:	Shaft
Option B:	Hole
Option C:	Small pin holes
Option D:	Tapered holes
10.	In case of profile projector, the beams of light are made to become parallel and almost of same intensity by
Option A:	Collimating lens
Option B:	Projection lens
Option C:	Objective lens
Option D:	eye piece lens
11.	The proper alignment of micrometer anvil with the thread axis during the measurement of effective diameter of a screw thread is ensured by
Option A:	Best wire method
Option B:	Three wire method
Option C:	one wire method
Option D:	Two wire method
12.	The main use of a tool maker's microscope is in measuring
Option A:	phase shift of monochromatic light
Option B:	shape, size, and angle of small components
Option C:	biological degradation of small machine components
Option D:	contours of large machine parts
13.	The thread angle and form are usually measured by
Option A:	Optical Means
Option B:	Mechanical means
Option C:	Electrical means
Option D:	Electronic means
14.	The four categories of costs associated with product quality costs are :
Option A:	External failure, internal failure, repair, and appraisal
Option B:	Warranty, product liability, training, and appraisal

Option C:	External failure, internal failure, prevention, and appraisal
Option D:	External failure, internal failure, prevention, and inspection
15.	How many basic steps are involved in Six Sigma?
Option A:	4
Option B:	5
Option C:	3
Option D:	6
16.	What is meant by P, D, C and A in PDCA cycle?
Option A:	Progress Development Check Act
Option B:	Plan Do Check Act
Option C:	Project Development Check Act
Option D:	Prevention Do Check Act
17.	What are the factors causing sampling error?
Option A:	method of sample selection
Option B:	sample size
Option C:	both method of sample selection and sample size
Option D:	Experience of the machine operator
18.	An operating characteristic curve (OC curve) is a plot between
Option A:	Consumers' risk and producers' risk
Option B:	Probability of acceptance and probability of rejection
Option C:	Percentage of defective and probability of acceptance
Option D:	Average outgoing quality and probability of acceptance
19.	Which among the following is not a type of Non-destructive testing?
Option A:	compression test
Option B:	visual testing
Option C:	ultrasonic testing
Option D:	eddy current testing
20.	Which test can be performed without skilled labour?
Option A:	Dye penetrant testing
Option B:	Radiographic inspection
Option C:	Ultrasonic testing
Option D:	Magnetic particle test

Q2.	Solve any Two Questions out of Three 10 marks each
A	Define roughness, waviness, lay, roughness, flow and roughness width cut –off with respect to surface texture.
B	Explain Taylor's Principle of limit gauges with suitable example.
C	Explain with neat labelled diagram working principle of floating carriage micrometer

Q3.	
A	Solve any Two 5 marks each
i.	Differentiate between systematic and random error
ii.	Explain Acceptable Quality level and indifferent quality level with their

	significance.	
iii.	Illustrate working of dye penetrant test used in NDT	
B	**Solve any One**	**10 mark each**
i.	Explain the construction and working principle of autocollimator	
ii	Classify types of prevention cost and mention their significance.	

University of Mumbai
Examination 2020 under cluster 09 (FAMT)
Examinations Commencing from 23rd December 2020 to 6th January 2021
Program: BE Mechanical Engineering
Curriculum Scheme: **Revised 2016**
Examination: **Third Year Semester VI**
Course Code: **MEC602** and Course Name: **Machine Design-I**

Time: 2 hours   Max. Marks: 80

Note : Each question is for 2 marks.

Multiple Choice Questions (MCQ)	
Q.1.	**Choose the correct option for following questions.** **All the Questions are compulsory and carry equal marks**
1.	Which design consideration deals with appearance of the product?
Option A:	Ergonomics
Option B:	Aesthetics
Option C:	System design
Option D:	Creative design
2.	A cotter joint is transmitting a load of 60KN, cotter thickness is 13mm and allowable shear stress is 32 N/mm^2 find the mean width of cotter considering double shear failure.
Option A:	72.11mm
Option B:	85mm
Option C:	65.11mm
Option D:	60mm
3.	The criterion of failure for machine parts subjected to fluctuating stresses is
Option A:	Ultimate tensile strength
Option B:	Yield strength
Option C:	Endurance limit
Option D:	Modulus of elasticity
4.	Find diameter of a shaft if torque transmitted by the shaft is 150 kN-mm and permissible shear stress for shaft material is 52 N/mm^2.
Option A:	38mm
Option B:	25mm
Option C:	18mm
Option D:	48mm
5.	A symbol Fe360 indicates a steel with
Option A:	Minimum Tensile Strength 360 N/mm^2
Option B:	Maximum Tensile Strength 360 N/mm^2
Option C:	Minimum shear Strength 360 N/mm^2
Option D:	Maximum shear Strength 360 N/mm^2
6.	In the assembly of pulley, key and shaft :
Option A:	pulley is made the weakest
Option B:	key is made the weakest
Option C:	key is made the strongest
Option D:	all the three are designed for equal strength

7.	In a thick cylindrical shell, the maximum radial stress at the outer surfaces of the shell is
Option A:	Zero
Option B:	P
Option C:	p/2
Option D:	2p
8.	In case of leaf spring, find the load exerted on the band after assembling the spring for a load (2W) = 70 kN, total number of leaves = 18, number of graduates leaves = 15.
Option A:	9860 N
Option B:	7256 N
Option C:	5690 N
Option D:	4487 N
9.	A self-locking screw has
Option A:	Fine threads
Option B:	Coarse threads
Option C:	Friction angle >helix angle
Option D:	Hole for insertion of split pin
10.	The resistance to fatigue of a material is measured by
Option A:	Elastic limit
Option B:	Young's modulus
Option C:	Ultimate tensile strength
Option D:	Endurance limit
11.	The thickness of thick cylindrical shell with closed ends and made of brittle material is determined by
Option A:	Barlow's equation
Option B:	Clavarino's equation
Option C:	Birnie's equation
Option D:	Lame's equation
12.	A Rigid Flange coupling is used to two shafts
Option A:	Which are perfectly aligned.
Option B:	Which are not in exact alignment.
Option C:	Have lateral misalignment.
Option D:	Whose axes intersect at a small angle.
13.	The solid length of the spring is given by_____. Where, n = total number of coils; d = diameter of wire
Option A:	n d
Option B:	(n + 1) d
Option C:	(n +3) d
Option D:	(n + 4) d
14.	Which of the following is a permanent fastening
Option A:	Bolts
Option B:	Keys
Option C:	Cotter
Option D:	rivets
15.	A key way lowers
Option A:	the strength of the shaft
Option B:	the rigidity of the shaft
Option C:	both the strength and rigidity of the shaft
Option D:	the ductility of the shaft

16.	Wahl's stress factor _____
Option A:	is independent of change in spring index
Option B:	decreases first and then starts increasing with the increase in spring index
Option C:	increases more rapidly as spring index decreases
Option D:	increases more rapidly as spring index increases

17.	The ------------- is used to adjust axial length between two rods.
Option A:	Cotter joint
Option B:	Knuckle joint
Option C:	Turn buckle
Option D:	Coupling

18.	Spring index for a helical spring is 5 and diameter of the wire is 6 mm. Calculate outer diameter of the coil.
Option A:	10 mm
Option B:	24 mm
Option C:	36 mm
Option D:	16 mm

19.	A Bolt of M24×2 means that
Option A:	The pitch of thread is 24mm and depth is 2 mm.
Option B:	The cross sectional area of the thread is 24 mm^2
Option C:	Nominal diameter of bolt is 24mm and pitch is 2 mm.
Option D:	Effective diameter of bolt is 24mm and there are 2 threads per cm.

20.	Flexible coupling is used because.......
Option A:	It is easy to disassemble
Option B:	It is easy to engage and disengage
Option C:	It transmits shocks gradually
Option D:	It prevents shock transmission and eliminates stress reversals

SUBJECTIVE/DESCRIPTIVE QUESTIONS	
Q2	**Solve any Four Questions out of Six** **Each question is for 5 marks.**
A	Explain Notch sensitivity and Endurance limit related to design of machine elements subjected to variable loads.
B	What is preferred number? Explain use of preferred number in engineering design?
C	Explain the nipping of the leaf spring with neat sketch.
D	What are the assumptions made in analysis of curved beam
E	Explain aesthetic consideration in design with suitable examples.
F	What is the necessity of theories of failure? List different theories of failure

Q3	**Solve any Two Questions out of Three** **Each question is for 10 marks.**
A	Design screw, nut, and handle of screw jack to lift a load of 90kN through a height of 400mm. select suitable material and factor of safety to design screw jack.
B	Design flange coupling to connect the output shaft of an electrical motor to the shaft of centrifugal pump. The motor delivers a power of 20KW at 960rpm. The overall torque for motor is 18% higher of mean torque.
C	Design socket and spigot joint for a load of 100kN. Select suitable material, factor of safety and draw neat sketch.

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Program: BE Mechanical Engineering
Curriculum Scheme: Rev 2016
Examination: TE   Semester VI
Course Code: MEC603 and Course Name: Finite Element Analysis

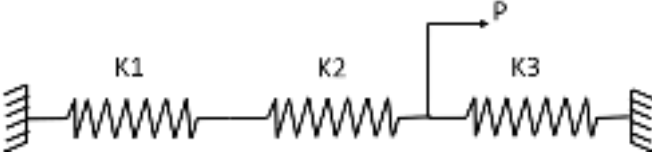Time: 2 hour   Max. Marks: 80

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Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Which one of the following is not the recent proposed modified FEM?
Option A:	Partition of Unity Method
Option B:	h-p Cloud Method
Option C:	Meshless Method
Option D:	Point Cloud Method
2.	The order and degree of differential equation is $$3\frac{d^2y}{dx^2} - \frac{dy}{dx} + 8 = 0$$
Option A:	0 and 1 respectively
Option B:	1 and 2 respectively
Option C:	2 and 1 respectively
Option D:	2 and 2 respectively
3.	The art of subdividing the structure into a convenient number of smaller elements is known as
Option A:	Assemblage
Option B:	Continuum
Option C:	Traction
Option D:	Discretization
4.	Number of node/s in a quadratic bar element is/are _____
Option A:	2
Option B:	3
Option C:	4
Option D:	1
5.	Beam element is
Option A:	1D element with 1degree of freedom
Option B:	1D element with 2 degree of freedom
Option C:	2D element with 1degree of freedom

Option D:	2D element with 2 degree of freedom
6.	The order of shape functions for CST element is
Option A:	Linear
Option B:	Quadratic
Option C:	Constant
Option D:	Either quadratic or constant
7.	Which one of the following is not a part of steps involved in assembly of different matrices?
Option A:	Rules for primary variables
Option B:	Rules for secondary variables
Option C:	Rules for stiffness matrix
Option D:	Impose local boundary conditions
8.	The governing equation for horizontal bar is
Option A:	$\dfrac{d}{dx}\left[EA\dfrac{du}{dx}\right] + f = 0$
Option B:	$\dfrac{d}{dx}\left[EA\dfrac{du}{dx}\right] = 1$
Option C:	$\dfrac{d}{dx}\left[EA\dfrac{du}{dx}\right] - f = 0$
Option D:	$\dfrac{d}{dx}\left[EA\dfrac{du}{dx}\right] = 0$
9.	What is the approximate function to be assumed?
Option A:	A polynomial function only
Option B:	A trigonometric function only
Option C:	Either polynomial or trigonometric function
Option D:	Neither polynomial nor trigonometric function
10.	Which of the following method is nothing but finite element method?
Option A:	Rayleigh Ritz method
Option B:	Piece-wise Rayleigh Ritz method
Option C:	Galerkin method
Option D:	Collocation method
11.	The element stiffness matrix equation for a eight node 2D element is of order
Option A:	4x4
Option B:	6x6
Option C:	8x8
Option D:	16x16
12.	Plane stress conditions are preferred when

Option A:	Thickness is very large compared to size of the domain
Option B:	Thickness is very less compared to size of the domain
Option C:	Thickness is negligible compared to size of the domain
Option D:	Thickness is same as compared to size of the domain
13.	The degree of freedom of 4-noded quadrilateral element at each node is
Option A:	1
Option B:	3
Option C:	2
Option D:	4
14.	The ratio of biggest side of element to its smallest side is called
Option A:	Path ratio
Option B:	Element ratio
Option C:	Coordinate ratio
Option D:	Aspect ratio
15.	The Stress-Strain Relation (D) Matrix for 2D Plane Stress Condition is of the order
Option A:	2x2
Option B:	3x3
Option C:	4x4
Option D:	6x6
16.	The element Stiffness matrix is given by
Option A:	$\int_v [B]^T [D][B] dv$
Option B:	$\int_t [B]^T [D][B] dt$
Option C:	$\int_a [B]^T [D][B] da$
Option D:	$\int_x [B]^T [D][B] dx$
17.	For a beam element, the Consistent mass matrices is given by,
Option A:	$\dfrac{\rho\,Al}{420}\begin{bmatrix} 156 & 22l & -54 & 13l \\ 22l & 4l^2 & -13l & 3l^2 \\ -54 & -13l & 156 & -22l \\ 13l & 3l^2 & -22l & 4l^2 \end{bmatrix}$
Option B:	$\dfrac{\rho\,Al}{420}\begin{bmatrix} 156 & 22l & 54 & -13l \\ 22l & 4l^2 & -13l & 3l^2 \\ 54 & -13l & 156 & -22l \\ -13l & 3l^2 & -22l & 4l^2 \end{bmatrix}$

Option C:	$$\frac{\rho\,Al}{420}\begin{bmatrix} 156 & 22l & 54 & -13l \\ 22l & 4l^2 & 13l & -3l^2 \\ 54 & 13l & 156 & -22l \\ -13l & -3l^2 & -22l & 4l^2 \end{bmatrix}$$
Option D:	$$\frac{\rho\,Al}{420}\begin{bmatrix} 156 & 22l & 54 & 13l \\ 22l & 4l^2 & 13l & 3l^2 \\ 54 & 13l & 156 & 22l \\ 13l & 3l^2 & 22l & 4l^2 \end{bmatrix}$$
18.	Jacobian matrix for 2D analysis is a
Option A:	2x2 matrix
Option B:	3x3 matrix
Option C:	4x4 matrix
Option D:	6x6 matrix
19.	Which of the following analysis is not an example of dynamic analysis
Option A:	Crash Analysis of a Car
Option B:	Impact Analysis of a missile
Option C:	Earthquake Excitation
Option D:	Truss Analysis
20.	The mass matrices as a result considering the mass of the element at the nodes is
Option A:	Lumped mass matrices
Option B:	Consistent mass matrices
Option C:	Diagonal mass matrices
Option D:	Singular mass matrices

Q2 (20 Marks)	Solve any Two Questions out of Three (10 marks each)
A	Solve the following differential equation and determine y at x=0.5 using Galerkin Method. $-\dfrac{d^2 y}{dx^2} - 9y + 2x^2 = 0$ in the domain $0 \le x \le 1$ Boundary conditions are: y(0) = 0 and $\dfrac{dy}{dx}(1) = 1$
B	 Determine the nodal displacement and stress for the step bar shown in figure. Consider, L1 = L2 =200 mm, A1 = 200 mm2, A2 = 100 mm2, E1 = E2 = 200 GPa and P = 10,000 N.
C	Determine the natural Frequency of axial vibration of bar (E = 2.3×10^{11} N/m^2, ρ = 7800 kg/m^3, L=1 m) fixed at one end using lumped mass matrices and using two linear element.

Q3. (20 Marks)	Solve any Four out of Six, 5 marks each
A	What are the major five limitations of the FEA?
B	State the properties of the shape function. Write the shape functions ϕ_1 and ϕ_2 for a linear element at node 1 and 2 and show its variation over the element.
C	Find the displacement at internal nodes of the system shown. K1 = 2 N/mm, K2 = 4 N/mm, K3 = 6 N/mm and P = 20 N.
D	The shape function at a point P inside a CST element is 0.3, 0.4 and 0.3 respectively. If the nodal temperature values (T) at the nodes are [102, 85, 128] degrees respectively, determine the value of temperature in degree Celsius at point P.
E	Explain convergence and state the convergence criteria.
F	Explain lumped mass matrix.