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15MAT31

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Engineering Mathematics - III

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. An alternating current after passing through a rectifier has the form, $I = \begin{cases} I_0 \sin x & \text{for } 0 < x < \pi \\ 0 & \text{for } \pi < x < 2\pi \end{cases}$

where I_0 is the maximum current and the period is 2π. Express I as a Fourier series. **(08 Marks)**

b. Determine the constant term and the first cosine and sine terms of the Fourier series expansion of y from the following data: **(08 Marks)**

x^0	0	45	90	135	180	225	270	315
y	2	1.5	1	0.5	0	0.5	1	1.5

OR

2 a. Obtain the Fourier series expansion of the function, $f(x) = |x|$ in $(-\pi, \pi)$ and hence deduce that,

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots = \frac{\pi^2}{8}$$ **(06 Marks)**

b. Find the Fourier series expansion of the function,

$$f(x) = \begin{cases} \pi x & \text{in } 0 \le x \le 1 \\ \pi(2-x) & \text{in } 1 \le x \le 2 \end{cases}$$ **(05 Marks)**

c. The following table gives the variations of periodic current over a period.

t(sec)	0	$\frac{T}{6}$	$\frac{T}{3}$	$\frac{T}{2}$	$\frac{2T}{3}$	$\frac{5T}{6}$	T
A(amplitude)	1.98	1.30	1.05	1.3	−0.88	−0.25	1.98

Show by harmonic analysis that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of first harmonic. **(05 Marks)**

Module-2

3 a. Find the complex Fourier transform of the function $f(x) = \begin{cases} 1 & \text{for } |x| \le a \\ 0 & \text{for } |x| > a \end{cases}$. Hence evaluate

$$\int_0^\infty \frac{\sin x}{x} dx .$$ **(06 Marks)**

b. Find the Fourier sine transform of $\frac{e^{-ax}}{x}$. **(05 Marks)**

c. Compute the inverse z-transforms of $\frac{3z^2 + 2z}{(5z-1)(5z+2)}$. **(05 Marks)**

OR

4 a. Find the z-transform of $e^{-an}n + \sin n\frac{\pi}{4}$. **(06 Marks)**

b. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using z-transform. **(05 Marks)**

c. Find the Fourier cosine transform of, $f(x) = \begin{cases} 4x & 0 < x < 1 \\ 4 - x & 1 < x < 4 \\ 0 & x > 4 \end{cases}$. **(05 Marks)**

Module-3

5 a. Find the Correlation coefficient and equations of regression lines for the following data:

x	1	2	3	4	5
y	2	5	3	8	7

(06 Marks)

b. Fit a straight line to the following data:

x	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

(05 Marks)

c. Find a real root of the equation $xe^x = \cos x$ correct to three decimal places that lies between 0.5 and 0.6 using Regula-falsi method. **(05 Marks)**

OR

6 a. The following regression equations were obtained from a correlation table.

$y = 0.516x + 33.73$

$x = 0.516y + 32.52$

Find the value of (i) Correlation coefficient (ii) Mean of x's (iii) Mean of y's. **(06 Marks)**

b. Fit a second degree parabola to the following data:

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

(05 Marks)

c. Use Newton-Raphson's method to find a real root of $x\sin x + \cos x = 0$ near $x = \pi$, carry out three iterations. **(05 Marks)**

Module-4

7 a. The following data gives the melting point of an alloy of lead and zinc, where t is the temperature in °C and P is the percentage of lead in the alloy:

P%	60	70	80	90
t	226	250	276	304

Find the melting point of the alloy containing 84% of lead, using Newton's interpolation formula. **(06 Marks)**

b. Apply Lagrange's interpolation formula to find a polynomial which passes through the points $(0, -20)$, $(1, -12)$, $(3, -20)$ and $(4, -24)$ **(05 Marks)**

c. Find the approximate value of $\int_0^{\frac{\pi}{2}} \sqrt{\cos\theta}\, d\theta$ by Simpson's $\frac{3}{8}^{th}$ rule by dividing it into 6 equal parts. **(05 Marks)**

OR

8 a. From the following table :

x°	10	20	30	40	50	60
cos x	0.9848	0.9397	0.8660	0.7660	0.6428	0.5

Calculate $\cos 25^\circ$ using Newton's forward interpolation formula. **(06 Marks)**

b. Use Newton's divided difference formula and find f(6) from the following data:

x :	5	7	11	13	17
f(x) :	150	392	1452	2366	5202

(05 Marks)

c. Evaluate $\int_0^1 \frac{dx}{1+x}$ using Weddle's rule by taking equidistant ordinates. **(05 Marks)**

Module-5

9 a. Find the area between the parabolas $y^2 = 4x$ and $x^2 = 4y$ with the help of Green's theorem in a plane. **(06 Marks)**

b. Solve the variational problem $\delta\int_0^1 (12xy + y'^2)dx = 0$ under the conditions $y(0) = 3$, $y(1) = 6$. **(05 Marks)**

c. Prove that the shortest distance between two points in a plane is along the straight line joining them. **(05 Marks)**

OR

10 a. A cable hangs freely under gravity from the fixed points. Show that the shape of the curve is a catenary. **(06 Marks)**

b. Use Stoke's theorem to evaluate for $\vec{F} = (x^2 + y^2)i - 2xyj$ taken around the rectangle bounded by the lines $x = \pm a$, $y = 0$, $y = b$. **(05 Marks)**

c. Evaluate $\iint_S (yzi + zxj + xyk).\hat{n}ds$ where S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$ in the first octant. **(05 Marks)**

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15ME/MA32

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Material Science

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Draw FCC lattice and calculate its atomic packing factor. **(04 Marks)**

b. Classify crystal imperfection, explain points defect in detail. **(06 Marks)**

c. The surface of steel gear made of 1020 steel (0.2%C) is to be gas carburized at 927°C. calculate the time required to increase the carbon content to 0.4% at 1 mm below the surface if the carbon potential at surface is 1.2 wt%. erf(0.9) = 0.8 **(06 Marks)**

OR

2 a. Define creep, with a typical creep curve, explain three stages of creep. **(08 Marks)**

b. With the help of a neat conventional stress-strain diagram, explain behavior of mild steel, under tension till fracture. **(06 Marks)**

c. Draw S-N curve for steel. **(02 Marks)**

Module-2

3 a. Explain Hume Rathery rules for the formation of solid solution. **(06 Marks)**

b. Draw and explain the Iron-Carbon equilibrium diagram and label all the points and fields. **(10 Marks)**

OR

4 a. Explain the following with example:
i) Gibb's phase rule
ii) Lever rule **(10 Marks)**

b. Explain any four types of stainless steel based on their crystal structure. **(06 Marks)**

Module-3

5 a. What is TTT diagram? Explain with a neat diagram the martensitic transformation of austenite. **(08 Marks)**

b. Write notes on the following:
i) Annealing
ii) Carburizing **(08 Marks)**

OR

6 a. What is hardening? Explain with a neat sketch induction hardening. **(08 Marks)**

b. Briefly explain the composition, properties and applications of grey cast iron. **(08 Marks)**

Module-4

7 a. What are properties of ceramic materials? **(04 Marks)**

b. With a neat sketch, explain tape casting. **(06 Marks)**

c. Explain with a neat diagram, the processing of plastic by injection molding. **(06 Marks)**

OR

8 a. Explain working principle of optical fiber. **(06 Marks)**
b. What are the applications of shape memory alloys? **(06 Marks)**
c. Explain any two methods of NDT. **(04 Marks)**

Module-5

9 a. With a neat sketch, explain filaments winding. **(08 Marks)**
b. Explain production of composite materials by spray-up process. **(08 Marks)**

OR

10 a. A tensile load of 500 N is applied to a epoxy-glass fiber composite. If the cross section of the composite is 1 mm^2 and the volume of the fiber is 30% calculate the stess in the glass fiber when:
i) The load axis is parallel to the fiber
ii) The load axis is perpendicular to the fiber.
Take the values of Young's modulus for the glass fiber as 86 GN/m^2 and for matrix as 3.38 GN/m^2. **(06 Marks)**
b. Explain the following:
i) Production of MMC's by stir casting
ii) Pultrusion process. **(10 Marks)**

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15ME33

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Use of Thermodynamic data hand book is permitted.

Module-1

1 a. Explain Microscopic and Macroscopic approaches to thermodynamics. **(06 Marks)**

b. State and explain zeroth law of thermodynamic. **(04 Marks)**

c. The temperature T on a thermometric scale is defined as $T = a\ln K + b$ were a and b are constants. The values of K are found to be 1.83 and 6.78 at 0°C and 100°C respectively. Calculate the temperature for value of K = 2.42. **(06 Marks)**

OR

2 a. Obtain an expression for displacement adiabatic work (work done in an adiabatic process). **(06 Marks)**

b. Define heat and work with reference to thermodynamic point of view. **(04 Marks)**

c. A gas expands from an initial state where the pressure in 340KPa and the volume is 0.0425 m^3 to a final pressure of 136KPa. The relationship between the pressure and volume of the gas is PV^2 = constant. Determine the work done for this process. **(06 Marks)**

Module-2

3 a. Derive the steady flow energy equation for an open system. **(04 Marks)**

b. Show that the Kelvin – Planck and Clausiv's statement of the II law of thermodynamic are equivalent. **(06 Marks)**

c. A gaseous system undergoes three quasistatic processes in sequence. The gas initially at 5 bar 0.01m^3 is expanded at constant pressure. It is then further expanded according to the relation. $PV^{1.4}$ = C to 2 bar, 0.025m^3. The gas is then returned to the initial state during which process PV = constant calculate the work interaction in each of three process and the net work for the system. **(06 Marks)**

OR

4 a. Obtain a relation between COP's of a refrigerator and heat pump. **(06 Marks)**

b. State and explain the ideal Carnot cycle on P-V diagram. **(04 Marks)**

c. A series combination of two Carnot engines operates between the temperature of 180°C and 20°C. Calculate the intermediate temperature, if the engine produce equal amounts of work. **(06 Marks)**

Module-3

5 a. Explain the factors that render a process irreversible. **(06 Marks)**

b. Explain internal and external irreversibility with equation. **(04 Marks)**

c. A reversible engine operates between a source at 927°C and two sinks at 127°C and 27°C. The energy rejected at both the sinks is the same compute the engine efficiency. **(06 Marks)**

OR

6 a. State and prove Clausius inequality and hence define entropy. **(06 Marks)**

b. Plot and explain the Carnot cycle with help of temperature entropy diagram. **(04 Marks)**

c. A 10kg bar of cast iron initially at 400°C is quenched in a 20 litres water tank initially at 25°C. Assuming no heat transfer with the surroundings and no boiling away of liquid water calculate the net entropy change for the process. $C_{pcastiron} = 0.5$, $C_{pwater} = 4.187$ kJ/kg K. **(06 Marks)**

Module-4

7 a. Obtain an expression for maximum useful work for a system and control volume. **(06 Marks)**

b. Define Gibb's and Helmholtz functions and explain its significances. **(04 Marks)**

c. Exhaust gases leave an I.C engine at 750°C and 1 atm, after having done 450kJ per kg gas in the engine cylinder. Assume that the enthalpy of the gas is a function of temperature only and that $C_p = 1.1$ kJ/kg K. Assume the temperature of the surrounding to be 27°C. Calculate :

i) The available and unavailable parts of the energy in every kg gas discharged

ii) The ratio of available energy to start to the engine work. **(06 Marks)**

OR

8 a. Sketch and explain Throttling Calorimeter. **(08 Marks)**

b. Define the following terms : i) Dryness fraction ii) Latent heat iii) Total heat of wet steam iv) Superheated steam. **(04 Marks)**

c. Find the specific volume, enthalpy and internal energy of wet steam at 18 bar pressure and dryness fraction of 0.85. **(04 Marks)**

Module-5

9 a. Explain Dalton's law of partial pressure and Amagat's law of additive volumes with reference to ideal gas mixture. **(06 Marks)**

b. Derive an expression for internal energy and enthalpy of gaseous mixtures. **(04 Marks)**

c. A mixture of gases contains 1kg of CO_2 and 1.5kg of N_2. The pressure and temperature of the mixture are 3.5bar and 27°C. Determine for the mixture.

i) The mass and mole traction of each constituent gas

ii) Average molecular weight

iii) The partial pressures. **(06 Marks)**

OR

10 a. Explain the following :

i) Generalized compressibility chart

ii) Law of corresponding states

iii) Compressibility factor **(06 Marks)**

b. Derive Vander Waal's constants interms of critical properties. **(06 Marks)**

c. Determine the pressure exerted by CO_2 in a container of $1.5m^3$ capacities when it contains 5kg at 27°C.

i) Using ideal gas equations

ii) Using Vander Waal's equation. **(04 Marks)**

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15ME/MA34

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Draw the stress-strain diagram of a M-S specimen subjected to tension test and explain the salient points. **(06 Marks)**

b. Determine the magnitude of the load P necessary to produce zero net change in the length of a straight bar shown in Fig.Q1(b). Area A = 400 mm^2.

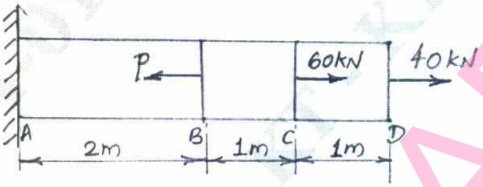

Fig.Q1(b) **(10 Marks)**

OR

2 a. Define Poisson's ratio. Derive an expression for volumetric strain of a rectangular bar subjected to normal stress along the three axis. **(08 Marks)**

b. A composite bar is rigidly fitted at the supports A and B as shown in Fig.Q2(b). Determine the reactions at the supports when temperature rises by 20°. Take E_A = 70 GPa, E_S = 200 GPA, $\alpha_A = 11 \times 10^{-6}$/°C and $\alpha_S = 12 \times 10^{-6}$/°C.

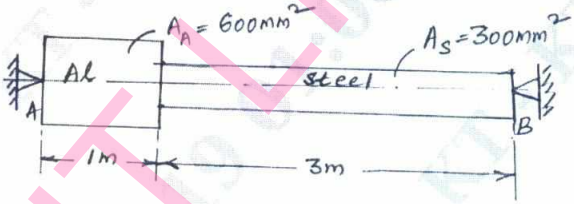

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Derive an expression for the normal stress and shear stress on a plane inclined at 'θ' to the vertical axis in a biaxial stress system. **(06 Marks)**

b. At a point in a strained material, the stresses on two planes at right angles to each other are 80 N/mm^2 (tensile) and 40 N/mm^2 (tensile). Each of the above stresses are accompanied by a shear stress of 60 N/mm^2. Determine normal stress, shear stress and resultant stress on an inclined plane (oblique plane) at an angle of 45° to the axis of minor tensile stress. Also find major principal stress, minor principal stress and their location. **(10 Marks)**

OR

4 a. Derive an expression for circumferential and longitudinal stress in a thin cylinder subjected to internal pressure p. **(06 Marks)**

b. A thick cylindrical pipe of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 20 N/mm^2 and external fluid pressure of 5 N/mm^2. Determine the maximum Hoop stress developed. Draw the variation of Hoop stress and radial stress across the thickness of the pipe indicating the values at every 25 mm interval. **(10 Marks)**

Module-3

5 a. Derive an expression to establish a relationship between intensity of load, shear force and bending moment. **(06 Marks)**

b. Draw the shear force and bending moment diagram for the beam loaded as shown in Fig.Q5(b). Locate the point of contraflexure if any.

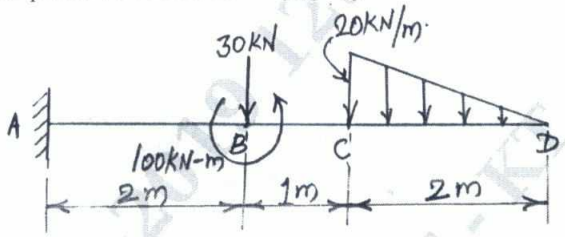

Fig.Q5(b) **(10 Marks)**

OR

6 a. A simply supported beam of 'I' section carries a uniformly distributed load of 40 kN/m run on entire span of beam of 10 m. If 'I' section is having dimensions as shown in Fig.Q6(a), determine the maximum stress developed due to bending.

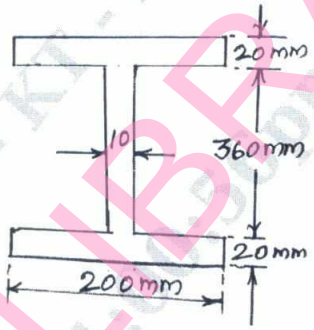

Fig.Q6(a) **(08 Marks)**

b. Find the deflection at the free end of cantilever beam shown in Fig.Q6(b). Take $E = 2 \times 10^5$ N/mm^2, $I = 180 \times 10^6$ mm^4.

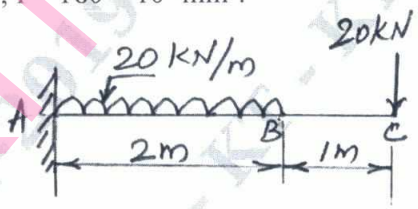

Fig.Q6(b) **(08 Marks)**

Module-4

7 a. Derive the torsion equation $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$ with usual notations. **(08 Marks)**

b. A hollow circular shaft has to transmit 60 kW at 210 rpm such that the maximum shear stress does not exceed 60 MN/m^2. If the ratio of internal to external diameter is equal to $\frac{3}{4}$ and the value of rigidity modulus is 84 GPa, find the dimensions of the shaft and angle of twist in a length of 3m. **(08 Marks)**

OR

8 a. Derive Euler's equation of a column with one end fixed and other end free. **(06 Marks)**

b. A 1.5 m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed and the other end is free. Taking factor of safety as 3, calculate the safe load using:

i) Rankine's formula, taking yield stress 560 N/mm^2 and $\alpha = \frac{1}{1600}$.

ii) Euler's formula, taking E = 1.2×10^5 N/mm^2. **(10 Marks)**

Module-5

9 a. State and explain three main theories of failure applicable to complex stress system. **(06 Marks)**

b. A bolt is acted upon by an axial pull of 16 kN along with a transverse shear force of 10 kN. Determine the diameter of the bolt required, using

i) Max. principal stress theory

ii) Max. shear stress theory

iii) Max. strain theory

Elastic limit in tension = 250 MPa

Factor of safety = 2.5

Poisson's ratio = 0.3 **(10 Marks)**

OR

10 a. Write a note on:

i) Castigliano's I theorem

ii) Strain energy due to bending and torsion. **(06 Marks)**

b. The maximum stress produced by a pull in a bar of length 1100 mm is 100 N/mm^2. The area of cross sections of length are shown in Fig.Q10(b). Calculate the strain energy stored in the bar if E = 2×10^5 N/mm^2.

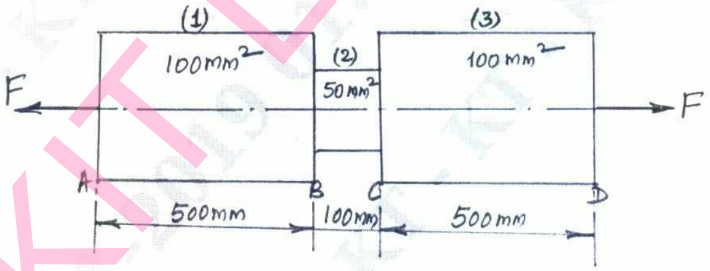

Fig.Q10(b) **(10 Marks)**

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15MEA305/15ME35A

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Name the factors that determine the selection of a casting alloy. **(04 Marks)**
b. Explain various pattern allowances. **(08 Marks)**
c. What are the requirements of base sand? **(04 Marks)**

OR

2 a. Explain the working of a sand slinger with a neat sketch. **(08 Marks)**
b. Explain with neat figures, shell moulding technique. **(08 Marks)**

Module-2

3 a. Explain with a diagram the working of electrical arc furnace. **(08 Marks)**
b. Explain with a neat figure, the principle of working of resistance furnace. **(08 Marks)**

OR

4 a. Explain continuous casting process with a neat sketch. **(08 Marks)**
b. Explain squeeze casting process with diagrams. **(08 Marks)**

Module-3

5 a. Name the solidification variables and explain them briefly. **(06 Marks)**
b. List the advantages and limitations of casting process. **(06 Marks)**
c. What is meant by grain refining and pouring temperature of aluminium castings? **(04 Marks)**

OR

6 a. Explain various degasification methods in liquid metals. **(08 Marks)**
b. Enlist the advantages and limitations of aluminium castings. **(04 Marks)**
c. Explain the reasons for fluxing and flushing of aluminium castings. **(04 Marks)**

Module-4

7 a. Define welding. Enumerate the advantages and limitations of welding. **(05 Marks)**
b. Describe the working of submerged arc welding with a neat diagram. **(05 Marks)**
c. Explain the principle of operation of seam welding process with a neat sketch. **(06 Marks)**

OR

8 a. Explain the flux shielding metal arc welding with a sketch. **(08 Marks)**
b. Explain the principle of spot welding with a neat sketch. **(08 Marks)**

Module-5

9 a. Explain the formation of different zones in weld with a neat sketch. **(08 Marks)**
b. Define soldering. Explain the mechanism of soldering. **(04 Marks)**
c. Differentiate between soldering and brazing. **(04 Marks)**

OR

10 a. Explain the principle of Oxy-acetylene welding. **(03 Marks)**
b. Explain the types of flames in oxy-acetylene welding with sketches. **(06 Marks)**
c. Briefly explain non-destructive testing method in welding. Mention its advantages limitations. **(07 Marks)**

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15MEB305

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. With a neat sketch show major parts of the centre lathe. **(06 Marks)**

b. Describe the following:
(i) Sensitive drilling machine.
(ii) Deep hole drilling machine **(10 Marks)**

OR

2 a. Explain principal parts of column and knee type milling machine. **(08 Marks)**

b. With the help of block diagram, explain the working of a centre type cylindrical grinding machine. **(08 Marks)**

Module-2

3 a. Explain the following machining process with neat sketches: (i) Reaming (ii) Boring. **(08 Marks)**

b. Explain the following milling methods:
(i) Straddle milling
(ii) End milling **(08 Marks)**

OR

4 a. With sketches pertaining to relative motions between tool and work piece, explain the following shaper operations:
(i) Machining horizontal surface.
(ii) Machining vertical surface.
(iii) Machining angular surface. **(12 Marks)**

b. Explain broaching process with illustration. **(04 Marks)**

Module-3

5 a. What are the desirable characteristics of cutting tool materials? **(04 Marks)**

b. With a neat sketch briefly, explain the following for a single point cutting tool:
(i) Back rake angle.
(ii) End clearance angle.
(iii) Side rake angle.
(iv) Side relief angle. **(12 Marks)**

OR

6 a. Explain the effect of machining parameters on surface finish. **(06 Marks)**

b. List the various functions of a cutting fluid in metal cutting. **(05 Marks)**

c. Determine the machining time required for machining of a work 350 mm long and 50 mm diameter in a lathe. The cutting speed is 30 m/min and the feed rate is 0.4 mm per revolution. **(05 Marks)**

Module-4

7 a. Briefly explain the different types of chips produced during metal cutting with neat sketches. **(09 Marks)**

b. In an orthogonal cutting operation of a material with yield strength of 250 N/mm^2. The following data is obtained:

Rake angle of the tool = 15 degree
Uncut chip thickness = 0.25 mm
Width of chip = 2 mm
Chip thickness ratio = 0.46
Friction angle $\beta = 40$ degree

Determine the shear angle ϕ, the cutting force component and resultant force on the tool. **(07 Marks)**

OR

8 a. Give the difference between orthogonal cutting and oblique cutting with neat sketches. **(08 Marks)**

b. With aid of suitable sketches, explain clearly the concepts of upmilling and down milling. **(08 Marks)**

Module-5

9 a. Explain the types of tool wear with necessary sketches. **(09 Marks)**

b. A mild steel bars of diameter 50 mm are to be turned at over length of 160 mm with a depth of cut of 1.5 mm, feed of 0.2 mm/rev at 230 rpm by HSS tools. If the tool life equation is given, $VT^{0.2}f^{0.3}d^{0.12} = 50$
Determine how many components may be turned before regrinding the tool. **(07 Marks)**

OR

10 a. Explain the effect of process parameters on tool life. **(08 Marks)**

b. Explain machinability. **(04 Marks)**

c. Explain effect of variations in cutting speed on various cost factors. **(04 Marks)**

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CBCS SCHEME

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15MEB306

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Describe the type of errors encountered during the measurement process. **(08 Marks)**

b. Three 100 mm end bars are measured on a level comparator by first wringing them together and comparing with 300 mm bar which itself has +0.03 mm error. Three bars together have total error of 0.064 mm less than the standard bar. Bar A is 0.02 mm larger than bar B and 0.025 mm longer than bar C. Determine the actual dimensions of all end bars. **(08 Marks)**

OR

2 a. With a neat sketch, explain the use of Auto collimator to measure squareness of surfaces. **(08 Marks)**

b. Mention the availability of flip gauges in M112 set. Using M112 set slip gauges build dimensions (i) 52.498 mm (ii) 48.3275 mm. **(08 Marks)**

Module-2

3 a. With a common zero line, indicate and define the following terms for shaft and hole (i) Basic size (ii) Allowance (iii) Upper deviation (iv) Lower deviation. **(08 Marks)**

b. Determine the actual dimensions to be provided for a shaft and hole of 90 mm size for H_8e_9 type fit. IT8 = 25 i, IT9 = 40i. FD for 'e' shaft = $-11D^{0.41}$ **(08 Marks)**

OR

4 a. Explain the construction and working of LVDT. **(08 Marks)**

b. Explain the construction and working of Zeiss ultra optimeter. **(08 Marks)**

Module-3

5 a. What is best wire size? Derive an expression for best wire diameter in terms of pitch and thread angle. **(08 Marks)**

b. Describe the use of David Brown tangent comparator for gear measurement. Calculate the dimension of the base tangent length over 3 teeth with module of 2.5 mm, 20° pressure angle and 30 teeth. **(08 Marks)**

OR

6 a. Explain the construction and working of laser interferometer. **(08 Marks)**

b. Describe the working of cantilever type CMM. **(08 Marks)**

Module-4

7 a. Describe (i) Accuracy (ii) Precision (iii) Calibration (iv) Threshold **(08 Marks)**

b. Explain the pressure sensitive elements used as mechanical transducers. **(08 Marks)**

OR

8 a. Explain the inherent problems in mechanical systems. **(08 Marks)**

b. Describe the working of stylus type oscillograph. **(08 Marks)**

Module-5

9 a. Describe the construction and working of proving ring. **(08 Marks)**

b. Describe the construction and working of prony brake. **(08 Marks)**

OR

10 a. Describe the construction and working of strain gauge load cell. **(08 Marks)**

b. What is thermocouple? Explain the laws of thermocouple. **(08 Marks)**

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CBCS SCHEME

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15MEB306

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Describe the type of errors encountered during the measurement process. **(08 Marks)**

b. Three 100 mm end bars are measured on a level comparator by first wringing them together and comparing with 300 mm bar which itself has +0.03 mm error. Three bars together have total error of 0.064 mm less than the standard bar. Bar A is 0.02 mm larger than bar B and 0.025 mm longer than bar C. Determine the actual dimensions of all end bars. **(08 Marks)**

OR

2 a. With a neat sketch, explain the use of Auto collimator to measure squareness of surfaces. **(08 Marks)**

b. Mention the availability of flip gauges in M112 set. Using M112 set slip gauges build dimensions (i) 52.498 mm (ii) 48.3275 mm. **(08 Marks)**

Module-2

3 a. With a common zero line, indicate and define the following terms for shaft and hole (i) Basic size (ii) Allowance (iii) Upper deviation (iv) Lower deviation. **(08 Marks)**

b. Determine the actual dimensions to be provided for a shaft and hole of 90 mm size for H_8e_9 type fit. IT8 = 25 i, IT9 = 40i. FD for 'e' shaft = $-11D^{0.41}$ **(08 Marks)**

OR

4 a. Explain the construction and working of LVDT. **(08 Marks)**

b. Explain the construction and working of Zeiss ultra optimeter. **(08 Marks)**

Module-3

5 a. What is best wire size? Derive an expression for best wire diameter in terms of pitch and thread angle. **(08 Marks)**

b. Describe the use of David Brown tangent comparator for gear measurement. Calculate the dimension of the base tangent length over 3 teeth with module of 2.5 mm, 20° pressure angle and 30 teeth. **(08 Marks)**

OR

6 a. Explain the construction and working of laser interferometer. **(08 Marks)**

b. Describe the working of cantilever type CMM. **(08 Marks)**

Module-4

7 a. Describe (i) Accuracy (ii) Precision (iii) Calibration (iv) Threshold **(08 Marks)**

b. Explain the pressure sensitive elements used as mechanical transducers. **(08 Marks)**

OR

8 a. Explain the inherent problems in mechanical systems. **(08 Marks)**

b. Describe the working of stylus type oscillograph. **(08 Marks)**

Module-5

9 a. Describe the construction and working of proving ring. **(08 Marks)**

b. Describe the construction and working of prony brake. **(08 Marks)**

OR

10 a. Describe the construction and working of strain gauge load cell. **(08 Marks)**

b. What is thermocouple? Explain the laws of thermocouple. **(08 Marks)**

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CBCS SCHEME

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15MATDIP31

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Additional Mathematics – I

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Find the modulus and amplitude of $\frac{(3-\sqrt{2}i)^2}{1+2i}$. **(06 Marks)**

b. Find the cube root of $(1-i)$. **(05 Marks)**

c. Prove that $\left(\frac{1+\sin\theta+i\cos\theta}{1+\sin\theta-i\cos\theta}\right)^n = \cos\left(n\frac{\pi}{2}-n\theta\right)+i\sin\left(n\frac{\pi}{2}-n\theta\right)$. **(05 Marks)**

OR

2 a. For any three vector a, b, c show that $\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right] = 2\left[\vec{a}\,\vec{b}\,\vec{c}\right]$ **(06 Marks)**

b. Find the value of λ so that the vectors $\vec{a}=2\hat{i}-3\hat{j}+\hat{k}$, $\vec{b}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{c}=\hat{j}+\lambda\hat{k}$ are coplanar. **(05 Marks)**

c. Find the angle between the vectors $\vec{a}=5\hat{i}-\hat{j}+\hat{k}$ and $\vec{b}=2\hat{i}-3\hat{j}+6\hat{k}$ **(05 Marks)**

Module-2

3 a. Find the n^{th} derivative of $\cos x\cos 2x\cos 3x$. **(06 Marks)**

b. If $y = a\cos(\log x)+b\sin(\log x)$, prove that $x^2y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n = 0$. **(05 Marks)**

c. Find the angle between the radius vector and tangents for the curve $r^2\cos 2\theta = a^2$ **(05 Marks)**

OR

4 a. If $u = e^{ax+by}+(ax-by)$ prove that $b\frac{\partial u}{\partial x}+a\frac{\partial u}{\partial y} = 2abu$. **(06 Marks)**

b. If $u = \sin^{-1}\left(\frac{x^2+y^2}{x-y}\right)$ prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y} = \tan u$. **(05 Marks)**

c. If $x = u(1-v)$, $y = uv$. Find $\frac{\partial(x,y)}{\partial(u,v)}$. **(05 Marks)**

Module-3

5 a. Obtain the reduction formula for $\int_0^{\frac{\pi}{2}}\cos^n x\,dx$ $(n>0)$. **(06 Marks)**

b. Evaluate $\int_0^1 x^6\sqrt{1-x^2}\,dx$. **(05 Marks)**

c. Evaluate $\int_0^1\int_0^1\int_0^y xyz\,dx\,dy\,dz$. **(05 Marks)**

OR

6 a. Obtain the reduction formula for $\int_0^{\frac{\pi}{2}} \sin^n x dx$, $n > 0$. **(06 Marks)**

b. Evaluate $\int_0^a x^2(a^2 - x^2)^{\frac{3}{2}} dx$. **(05 Marks)**

c. Evaluate $\int_0^1 \int_0^{\sqrt{x}} xy dy dx$. **(05 Marks)**

Module-4

7 a. A particle moves along a curve $x = e^{-t}$, $y = 2\cos 3t$, $z = 2\sin 3t$ where t is the time. Determine the component of velocity and acceleration vector at t = 0 in the direction of $\hat{i} + \hat{j} + \hat{k}$. **(08 Marks)**

b. Find the value of the constant a, b, such that $\vec{F} = (axy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (bxz^2 - y)\hat{k}$ is irrotational. **(08 Marks)**

OR

8 a. If $\vec{F} = (x + y + 1)\hat{i} + \hat{j} - (x + y)\hat{k}$ show that $\vec{F} \cdot \text{curl}\vec{F} = 0$. **(06 Marks)**

b. If $\phi(x, y, z) = x^3 + y^3 + z^3 - 3xyz$ find $\nabla\phi$ at (1, −1, 2). **(05 Marks)**

c. Find the directional derivative $\phi(x, y, z) = x^2yz + 4xz^2$ at (1,–2,–1) in the direction of $2\hat{i} - \hat{j} - 2\hat{k}$. **(05 Marks)**

Module-5

9 a. Solve $\frac{dy}{dx} = \frac{y}{x - \sqrt{xy}}$. **(06 Marks)**

b. Solve $ye^{xy}dx + (xe^{xy} + 2y)dy = 0$ **(05 Marks)**

c. $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$. **(05 Marks)**

OR

10 a. Solve $\frac{dy}{dx} = \frac{y}{x} + \sin\left(\frac{y}{x}\right)$. **(06 Marks)**

b. Solve $(y^3 - 3x^2y)dx - (x^3 - 3xyz)dy = 0$ **(05 Marks)**

c. Solve $(1 + y^2)dx + (x - \tan^{-1}y)dy = 0$ **(05 Marks)**

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