III ME, CV (5)

CBCS Scheme

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15MAT31

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Expand $f(x) = x - x^2$ as a Fourier series in the interval $(-\pi, \pi)$. **(08 Marks)**

b. Obtain the half-range cosine series for the function $f(x) = x(l - x)$ in the interval $0 \le x \le l$. **(08 Marks)**

OR

2 a. Obtain the Fourier series of $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2\pi$. Hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots\ldots$ **(06 Marks)**

b. Find the half-range sine series for the function

$$f(x) = \begin{cases} \frac{1}{4} - x & \text{in } 0 < x < 1/2 \\ x - \frac{3}{4} & \text{in } 1/2 < x < 1 \end{cases}.$$ **(05 Marks)**

c. Compute the constant term and the coefficient of the 1st sine and cosine terms in the Fourier series of y as given in the following table:

x:	0	1	2	3	4	5
y:	4	8	15	7	6	2

(05 Marks)

Module-2

3 a. If $f(x) = \begin{cases} 1 - x^2; & |x| < 1 \\ 0; & |x| \ge 1 \end{cases}$. Find the Fourier transform of f(x) and hence find the value of $\int_0^\infty \frac{x\cos x - \sin x}{x^3} dx$. **(06 Marks)**

b. Find the Fourier sine and cosine transform of

$$f(x) = \begin{cases} x, & 0 < x < 2 \\ 0, & \text{elsewhere} \end{cases}.$$ **(05 Marks)**

c. Solve using Z-transform $y_{n+2} - 4y_n = 0$ given that $y_0 = 0$, $y_1 = 2$. **(05 Marks)**

OR

4 a. Obtain the inverse Fourier sine transform of $F_S(\alpha) = \frac{e^{-a\alpha}}{\alpha}$, $a > 0$. **(06 Marks)**

b. Find the Z-transform of $2n + \sin\left(\frac{n\pi}{4}\right) + 1$. **(05 Marks)**

c. If $U(z) = \frac{z}{z^2 + 7z + 10}$, find the inverse Z-transform. **(05 Marks)**

Module-3

5 a. Obtain the coefficient of correlation for the following data:

x :	10	14	18	22	26	30
y :	18	12	24	6	30	36

(06 Marks)

b. By the method of least square find the straight line that best fits the following data:

x :	1	2	3	4	5
y :	14	27	40	55	68

(05 Marks)

c. Use Newton-Raphson method to find a root of the equation $\tan x - x = 0$ near $x = 4.5$. Carry out two iterations. **(05 Marks)**

OR

6 a. Find the regression line of y on x for the following data:

x :	1	3	4	6	8	9	11	14
y :	1	2	4	4	5	7	8	9

Estimate the value of y when $x = 10$. **(06 Marks)**

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

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

(05 Marks)

c. Solve $xe^x - 2 = 0$ using Regula – Falsi method. **(05 Marks)**

Module-4

7 a. From the data given in the following table. Find the number of students who obtained less than 70 marks.

Marks :	0-19	20-39	40-59	60-79	80-99
Number of students :	41	62	65	50	17

(06 Marks)

b. Find the equation of the polynomial which passes through the points (4, -43), (7, 83), (9, 327) and (12, 1053). Using Newton's divided difference interpolation. **(05 Marks)**

c. Compute the value of $\int_{0.2}^{1.4} (\sin x - \log x + e^x)dx$ using Simpson's $\frac{3}{8}^{th}$ rule taking six parts. **(05 Marks)**

OR

8 a. Using Newton's backward interpolation formula find the interpolating polynomial for the function given by the following table:

x :	10	11	12	13
f(x) :	22	24	28	34

Hence fine f(12.5). **(06 Marks)**

b. The following table gives the premium payable at ages in years completed. Interpolate the premium payable at age 35 completed. Using Lagrange's formula.

Age completed :	25	30	40	60
Premium in Rs. :	50	55	70	95

(05 Marks)

c. Evaluate $\int_{4}^{5.2} \log_e x \, dx$ taking 6 equal strips by applying Waddles rule. **(05 Marks)**

Module-5

9 a. Verify Green's theorem for $\oint (xy + y^2)dx + x^2 dy$ where c is the closed curve of the region bounded by y = x and y = xz. **(06 Marks)**

b. Verify Stoke's theorem for $\vec{F} = (x^2 + y^2)i - 2xy\,j$ taken round the rectangle bounded by the lines x = ±a, y = 0 and y = b. **(05 Marks)**

c. A heavy cable hangs freely under gravity between two fixed points. Show that the shape of the cable is a catenary. **(05 Marks)**

OR

10 a. Use divergence theorem to evaluate $\iint_S \vec{F}\,\hat{n}\,ds$ over the entire surface of the region above XoY plane bounded by the cone $z^2 = x^2 + y^2$, the plane z = 4 where $\vec{F} = 4xz^1\hat{i} + xyz^2\hat{j} + 3z\hat{k}$. **(06 Marks)**

b. Find the extremal of the functional $\int_{x_1}^{x_2} [(y^1)^2 - y^2 + 2y \sec x]dx$. **(05 Marks)**

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

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CBCS Scheme

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15ME/MA32

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. Define APF. Calculate APF for HCP cell. **(06 Marks)**

b. With neat sketches explain surface defects briefly. **(05 Marks)**

c. Explain briefly the mechanical properties of a material in plastic range. **(05 Marks)**

OR

2 a. With neat sketches, explain cup and cone fracture. **(05 Marks)**

b. What is stress relation? Obtain an expression for stress relaxation. **(06 Marks)**

c. With S-N diagram explain fatigue behaviour of a material. **(05 Marks)**

Module-2

3 a. Explain different types of solid solution with sketches. **(04 Marks)**

b. State lever rule and Gibbs phase rule. Also explain Hume-Rothary rules for formation of solid solution. **(06 Marks)**

c. Two metals A and B have their melting points at 900°C and 800°C respectively. The alloy pair forms eutectic at 600°C at 60% B and 40% A. Both A and B have unlimited solubilities in liquid state. The solid state solubilities are 10% B in A at 600°C and 5% B in A at 0°C, and 8% A in B at 600°C and 4% A in B at 0°C. Assume solidus, liquidus and solvus lines are to be straight. No intermediate phase change occurs. Draw phase diagram and label at temperatures, phases and fields. Also find the room temp structure of an alloy of composition 60% A and 40% B, with respect to the number, type, extent and composition of the phases. **(06 Marks)**

OR

4 a. Draw Fe – Fe_3C diagram. Label all phases, temperatures. Explain solidification process for any one alloy. **(08 Marks)**

b. Define Homogeneous and Heterogeneous nucleation. Obtain an expression for critical radius of nucleation. **(08 Marks)**

Module-3

5 a. Draw TTT diagram for eutectoid steel and explain briefly. **(06 Marks)**

b. Distinguish between Austempering and martempering. **(05 Marks)**

c. Explain Flame hardening with neat sketch. **(05 Marks)**

OR

6 a. Explain composition, properties and uses of Gray cast Iron, white cast iron and S. G Iron. **(06 Marks)**

b. Explain solution hardening of Al – 4%C alloy. **(05 Marks)**

c. Write a note on Austenitic and Martensitic stainless steel. **(05 Marks)**

Module-4

7 a. What are ceramics? Briefly explain the types of ceramics. **(05 Marks)**

b. Write a note on mechanical properties of ceramics. **(05 Marks)**

c. Define smart material. Explain briefly the types of smart materials. **(06 Marks)**

OR

8 a. Give classification of polymers. List the characteristics of polymers. **(05 Marks)**

b. With a neat sketch explain the processing of plastic by injection moulding method. **(05 Marks)**

c. Write a note on piezo-electric material and shape memory alloys. **(06 Marks)**

Module-5

9 a. Define composite. Give its classification. **(05 Marks)**

b. With a neat sketch, explain filament winding process. List the applications of filament winding process. **(06 Marks)**

c. What is the role of matrix and reinforcement in composite materials? **(05 Marks)**

OR

10 a. Under Iso stress condition, obtain an expression for Young's modulus of a fibre reinforced composites. **(06 Marks)**

b. List the advantages and applications of composite material. **(05 Marks)**

c. Calculate the tensile modulus of elasticity of unidirectional carbon-fibre reinforced composite containing 62% of carbon fibres by volume in ISO-stress and ISO – strain condition. Take $E_{carbon\ fibre} = 37.86 \times 10^4$ N/mm^2, $E_{epoxy} = 41.98 \times 10^2$ N/mm^2. **(05 Marks)**

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CBCS Scheme

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15ME33

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing ONE full question from each module.
2. Use of thermodynamic data hand book and steam tables is permitted.

Module-1

1 a. Define thermodynamics. Differentiate between open system, closed system and isolated system. **(04 Marks)**

b. State Zeroth Law of thermodynamics. What is diathermal wall and adiabatic wall? **(04 Marks)**

c. Estimate the % variation in temperature reading from a thermocouple having its test junction in gas and other reference junction at ice point. The temperature of gas using gas thermometer is found to be 50°C. Thermocouple is calibrated with e.m.f varying linearly between ice point and steam point when thermocouples test junction is kept in gas at t°C and reference junction at ice point, the e.m.f produced in milli volts is $e = 0.18t - 5.2 \times 10^{-4}t^2$. **(08 Marks)**

OR

2 a. Define heat and work in thermodynamics. Show that work is path function. **(08 Marks)**

b. A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to law PV^2= constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position. Heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid for an initial volume of $0.05m^3$. **(08 Marks)**

Module-2

3 a. State the first law of thermodynamics applied to cyclic process and non-cyclic process. **(05 Marks)**

b. Write the steady flow energy equation indicating all the terms in the equation. **(03 Marks)**

c. The working fluid in a steady flow process flows at the rate of 220 kg/min. The fluid rejects 100 kJ/s of heat passing through the system. The fluid enters at a velocity of 320 m/s, pressure of 6 bar, internal energy 2000 kJ/kg, specific volume of 0.36 m^3/kg and leaves the system at a velocity of 140 m/s, pressure of 1.2 bar, internal energy 1400 kJ/kg, specific volume 1.3 m^3/kg. Determine the power output in MW. The change in potential energy is neglected. **(08 Marks)**

OR

4 a. Show that Kelvin plank statement and Clausius statement are equivalent. **(08 Marks)**

b. A heat pump working on a reversible cycle takes in heat from a reservoir at 5°C and delivers heat to low temperature reservoir at 60°C. The heat pump is driven by a heat engine taking heat from source at 840°C and rejects heat to low temperature reservoir at 60°C. The engine also drives a machine of 30 KW capacity. If the heat pump extracts 17 kJ/s from high temperature reservoir at 5°C. Determine : i) rate of heat flow from reservoir at 840°C ii) rate of heat rejected to sink at 60°C. **(08 Marks)**

Module-3

5 a. Mention the factors which render a process irreversible. **(05 Marks)**

b. Explain reversible and irreversible process. **(03 Marks)**

c. A reversible engine operates between T_1 and T. The energy rejected by this engine is received by second reversible engine and heat is rejected to sink at T_2. Show that :
i) For same work T is arithmetic mean of T_1 and T_2
ii) for same efficiency T is geometric mean of T_1 and T_2. **(08 Marks)**

OR

6 a. State and prove Clausius inequality. **(08 Marks)**

b. 5 kg of copper block at 200°C is dropped to an insulated tank with 100 kg of oil at 30°C. Find the increase in entropy of the universe. Take $C_{P_{cu}} = 0.4 kJ/kg\,K$ and $C_{P_{oil}} = 2.1 kJ/kg\,K$. **(08 Marks)**

Module-4

7 a. What is available energy, unavailable energy and second law efficiency? **(04 Marks)**

b. Write Maxwell relations and explain the terms involved. **(04 Marks)**

c. Derive clausius Clayperon equation for evaporation of liquid and explain the significance. **(08 Marks)**

OR

8 a. Define : i) Sub cooled liquid ii) triple point iii) critical point. **(03 Marks)**

b. With a neat sketch explain the working of a throttling calorimeter. **(05 Marks)**

c. In a test to find the quality of the steam in a pipe using a combined separating and throttling calorimeter, the following data was obtained pressure of steam in the steam mains = 14 bar pressure of steam after throttling = 1.19 bar temperature after throttling = 120°C water collected in the separator = 0.45 kg steam condensed after throttling = 6.75 kg. Determine the condition of the steam in the mains. Take C_P for superheated steam $C_{P_S} = 2.1 kJ/kg\,k$. **(08 Marks)**

Module-5

9 a. Explain the reasons for deviations of Vander Walls equation from ideal gas equations. **(05 Marks)**

b. Write a note on compressibility chart. **(03 Marks)**

c. Determine the pressure exerted by carbon dioxide in a container of 1.5 m^3 capacity when it contains 5 kg at 27°C, using : i) Ideal gas equation ii) Vander Walls equation.
Take Vander Walls constants for CO_2 as a = 364.3 kN $m^4/kg\,mol^2$; b = 0.0427 m^3/kg mol. **(08 Marks)**

OR

10 a. Define :
i) Dry bulb temperature
ii) Wet bulb temperature
iii) Dew point temperature. **(03 Marks)**

b. Develop an expression to determine the gas constant of a mixture of ideal gases. **(05 Marks)**

c. A mixture of gases has the following volumetric composition : CO_2 = 12%, O_2 = 4%, N_2 = 82% and CO = 2%. Determine : i) the gravimetric composition ii) molecular weight of mixture iii) gas constant R for mixture. **(08 Marks)**

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CBCS Scheme

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15ME34/MA34

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

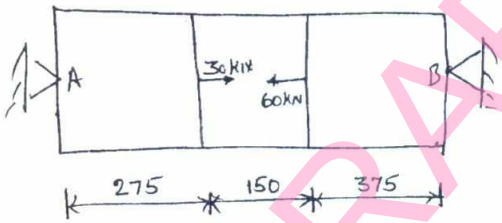
Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Explain with a neat sketch, stress – strain diagram of mild steel indicating its salient points. **(06 Marks)**

b. A bar of 800mm length is attached rigidly at 'A' and 'B' as shown in fig. Q1(b). Determine the reactions at the two ends, if the bar is 25mm diameter. Find the stresses and change in length in each portion. Take E = 200GPa. **(10 Marks)**

Fig.Q1(b)



OR

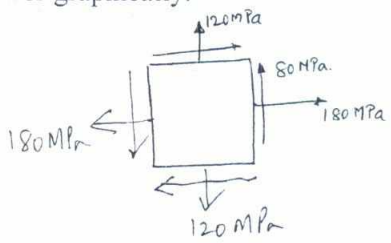
2 a. A bar of brass 25mm diameter is enclosed in a steel tube of 50mm external diameter and 25mm internal diameter. The bar and the tube are rigidly fastened at the ends and are 1.5m long. Find the stresses in the two materials when the temperature raises from 30^0C to 100^0C. Take $E_{steel} = 200kN/mm^2$ $E_{brass} = 100kN/mm^2$ **(08 Marks)**
$\alpha_{steel} = 11.6 \times 10^{-6}/^0C$ $\alpha_{brass} = 18.7 \times 10^{-6}/^0C$.

b. A circular rod of 100mm diameter and 500mm long is subjected to a tensile load of 1000kN. Determine the modulus of rigidity, Bulk modulus and change in volume if Poisson's ratio is 0.3. Take E = 200GPa. **(08 Marks)**

Module-2

3 The state of stress in a two dimensional stressed body is shown in fig.Q3. Determine the principal plane, principal stresses and maximum shear stresses. Sketch the results. Construct the Mohr's circle and verify the answer graphically. **(16 Marks)**

Fig.Q3



OR

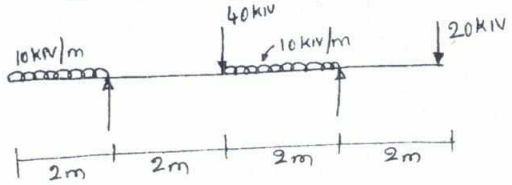
4 a. A thin cylinder 3m long is having 1m internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the cylinder if it is subjected to an internal pressure of $1.5N/mm^2$. **(08 Marks)**

b. A thick cylindrical vessel is 250mm internal diameter and has 50mm thick wall. It is subjected to an internal pressure of 10MPa due to the movement of the fluid. Find the maximum hoop stress developed in the cylinder. Also calculate the radial and hoop stresses at a point 20mm from the inner surface. Sketch the stresses. **(08 Marks)**

Module-3

5 Draw the shear force and bending moment diagrams for the beam shown in fig. Q5. **(16 Marks)**

Fig.Q5



OR

6 a. A cantilever of square section 200mm × 200mm, 2 m long just fails in flexure when a load of 12kN is placed at its free end. A beam of the same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum control point load required to break the beam. **(08 Marks)**

b. Using Double Integration method, determine the slope and deflection for a cantilever beam subjected to concentrated load at free end. **(08 Marks)**

Module-4

7 a. Explain Slenderness ratio. **(04 Marks)**

b. A shaft is required to transmit 245kN power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40MPa and the twist 1^0 per meter length. Determine the diameter required if :

i) the shaft is solid

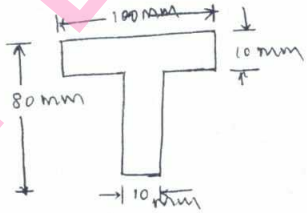
ii) the shaft is hollow with external diameter twice the internal diameter.

Take modules of rigidity. 80kN/mm^2. **(12 Marks)**

OR

8 a. Determine the buckling load for T – section shown below in fig.Q8(a). The column is 3m long and is hinged at both ends. Take E = 200GPa. **(10 Marks)**

Fig.Q8(a)



b. State the assumptions made in Pure torsion theory. **(06 Marks)**

Module-5

9 A bolt is subjected to an axial pull of 12kN together with a transverse shear of 6kN. Determine the diameter of the bolt by using : **(16 Marks)**

i) Maximum principal stress theory ii) Maximum shear stress theory.

Take Elastic limit in tension = 300 N/mm^2 ; Factor of safety = 3 ; Poisson's ratio = 0.3.

OR

10 Write a note on the following :

a. Castigliano's I theorem. **(04 Marks)**

b. Modulus of resilience. **(04 Marks)**

c. Strain energy due to bending and torsion. **(08 Marks)**

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CBCS Scheme

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15ME35A

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. Define manufacturing process. With a suitable sketch, explain the classification of manufacturing process. **(08 Marks)**

b. What is a pattern? State the functions of a pattern and classify it. **(08 Marks)**

OR

2 a. What do you mean by the term pattern allowance? With a suitable sketch elaborate different types of pattern allowance. **(08 Marks)**

b. Draw and explain the step followed in moduling using sand slinger. **(08 Marks)**

Module-2

3 a. Define furnace, sketch and explain the working principle, constructional feature of induction furnace (corless type). **(08 Marks)**

b. Draw and explain the basic principle of working of a resistance furnace. **(08 Marks)**

OR

4 a. Explain the principle of squeeze casting process with a suitable figure give the setup details. **(08 Marks)**

b. With a neat sketch, explain thixo casting and slush casting. **(08 Marks)**

Module-3

5 a. How are casting defects classified? List out the factors contributing casting defects. **(08 Marks)**

b. Define the term directional solidification. Explain the methods of achieving directional solidification and state the need for directional solidification. **(08 Marks)**

OR

6 a. With a suitable sketch, explain the following terms :
i) Homogeneous nucleation
ii) Heterogeneous nucleation. **(08 Marks)**

b. Define the term degasification. With suitable sketch explain any two methods of degasification. **(08 Marks)**

Module-4

7 a. Define welding process, classify it, list out the applications, advantages and limitations of it. **(08 Marks)**

b. With a suitable sketch explain the principle of resistance welding and classify it. **(04 Marks)**

c. Describe the process of spot welding with a neat sketch. **(04 Marks)**

OR

8 a. Explain how an arc is generated in arc welding. Classify it. With a neat sketch elaborate flux shielded metal arc welding process (FSMAW). **(08 Marks)**

b. Describe the setup of atomic hydrogen welding process with a neat sketch. **(08 Marks)**

Module-5

9 a. Discuss the formation of different zones during welding process. **(08 Marks)**

b. With a neat sketch, explain how crack or discontinuity are inspected in a component using magnetic particle test. **(08 Marks)**

OR

10 a. Draw and explain the types of flames in oxy-acctylene welding process. **(08 Marks)**

b. State the metallurgical aspects in welding process for carbon and high carbon steel. **(08 Marks)**

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15ME36B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the term metrology. List the objectives of measurement system. **(05 Marks)**

b. Explain line and end standards. **(06 Marks)**

c. Three 100mm end bars measured on a level comparator by first wringing them together and comparing with a 300mm bar. The 300mm bar has a known error of +40μm and the three bars together measure 64μm less than the 300mm bar. Bar A is 18μm longer than bar B and 23μm longer than bar C. Find the actual length of each bar. **(05 Marks)**

OR

2 a. Select the size of angle gauges required to build the following angles, also sketch the arrangement of sample i) 37°16′42″ ii) 35°32′36″ **(06 Marks)**

b. Sketch and explain sine bar. **(04 Marks)**

c. Explain the principle of autocollimeter with the help of a neat sketch. **(06 Marks)**

Module-2

3 a. Explain briefly the different types of fit and show them by neat schematic diagrams. **(08 Marks)**

b. Explain with neat sketch the significance of hole basis and shaft basis system. **(08 Marks)**

OR

4 a. Describe with neat sketch working of LVDT. Also write the advantages and disadvantages of LVDT. **(08 Marks)**

b. With neat sketch describe the construction and working of sigma comparator. **(08 Marks)**

Module-3

5 a. Explain with neat sketch the method of measuring minor diameter of external thread. **(08 Marks)**

b. Explain with neat sketch of Tool maker's microscope. **(08 Marks)**

OR

6 a. Explain with a neat sketch, Gear tooth thickness measurement using gear tooth vernier. **(08 Marks)**

b. Explain with neat sketch the construction and working principle of CMM, also write the applications. **(08 Marks)**

Module-4

7 a. Briefly explain the following terms :
i) Hysteresis ii) Accuracy iii) Precision iv) Threshold. **(08 Marks)**

b. Briefly explain the generalized measurement system with block diagram with an example. **(08 Marks)**

OR

8 a. What is CRO? Explain with sketch the principle and working of CRO. **(10 Marks)**

b. What is Ballast circuit? Explain. **(06 Marks)**

Module-5

9 a. Explain briefly with a neat sketch working of
i) Proving Ring ii) Prone brake dynometer. **(08 Marks)**

b. Explain with neat sketch the working principle of Mclead gauge. **(08 Marks)**

OR

10 a. What are the different methods of strain measurement? Explain mechanical strain gauge. **(08 Marks)**

b. With neat sketch explain the working principle of optical pyrometer. **(08 Marks)**

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CBCS Scheme

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15MATDIP31

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. Simplify $\frac{(\cos 3\theta - i\sin 3\theta)^2(\cos 4\theta + i\sin 4\theta)^5}{(\cos\theta + i\sin\theta)^3(\cos 2\theta - i\sin 2\theta)^4}$. **(06 Marks)**

b. Determine λ such that $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - 4\hat{k}$ and $\vec{c} = \hat{i} + \lambda\hat{j} + 3\hat{k}$ are coplanar. **(05 Marks)**

c. Find sine angle of two vectors $4\hat{i} + 3\hat{j} + \hat{k}$ and $2\hat{i} - \hat{j} + 2\hat{k}$. **(05 Marks)**

OR

2 a. Express $\frac{1}{2+i} - \frac{(1+i)^2}{3+i}$ in the form a + ib. **(06 Marks)**

b. Find modulus and amplitude of $1 + \cos\theta + i\sin\theta$. **(05 Marks)**

c. If $\vec{a} = 3\hat{i} + 7\hat{j} - 2\hat{k}$, $\vec{b} = 2\hat{i} + 5\hat{j} + 10\hat{k}$ find $(\vec{a} + \vec{b}) \times (\vec{a} - \vec{b})$. **(05 Marks)**

Module-2

3 a. If $y = a\cos(\log x) + b\sin(\log x)$ show that $x^2 y_{n+2} + (2n+1)xy_{n+1} + (n^2+1)y_n = 0$. **(06 Marks)**

b. With usual notation prove that $\tan\varphi = r\frac{d\theta}{dr}$. **(05 Marks)**

c. If $u = e^{ax+by} f(ax - by)$ prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu$. **(05 Marks)**

OR

4 a. Find n^{th} derivative of $y = e^x \sin 4x \cos x$ **(06 Marks)**

b. Find pedal equation of $r = a(1 + \cos\theta)$. **(05 Marks)**

c. If $u = f(x - y, y - z, z - x)$ show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. **(05 Marks)**

Module-3

5 a. Evaluate $\int_0^{\pi} \sin^5(x/2)dx$. **(06 Marks)**

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

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

OR

6 a. Evaluate $\int_0^a \frac{x^3 dx}{\sqrt{a^2 - x^2}}$. **(06 Marks)**

b. Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y \, dx \, dy$. **(05 Marks)**

c. Evaluate $\int_0^a \int_0^x \int_0^{x+y} e^{x+y+z} \, dz \, dy \, dx$. **(05 Marks)**

Module-4

7 a. A particle moves along the curve c : $x = t^3 - 4t$, $y = t^2 + 4t$, $z = 8t^2 - 3t^3$ where t denotes time. Find velocity and acceleration at t = 2. **(06 Marks)**

b. Find unit normal vector to surface $Q = x^2yz + 4xz^2$ at (1, -2, -1). **(05 Marks)**

c. Show that $\vec{f} = (2xy^2 + yz)\hat{i} + (2x^2y + xz + 2yz^2)\hat{j} + (2y^2z + xy)\hat{k}$ is irrotational. **(05 Marks)**

OR

8 a. A particle moves along the curve c : $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$ where 't' is the time. Find the components of velocity and acceleration at t = 1 in the direction $\hat{i} - 3\hat{j} + 2\hat{k}$. **(06 Marks)**

b. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at (2, -1, 2). **(05 Marks)**

c. If $\phi = 2x^3y^2z^4$ find div(gradϕ). **(05 Marks)**

Module-5

9 a. Solve : $\sec^2 x \tan y \, dx + \sec^2 y \tan x \, dy = 0$. **(06 Marks)**

b. Solve : $x^2y \, dx - (x^3 + y^3) \, dy = 0$. **(05 Marks)**

c. Solve : $(y^3 - 3x^2y) \, dx - (x^3 - 3xy^2) \, dy = 0$. **(05 Marks)**

OR

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

b. Solve : $(x^2 + y^2 + x)dx + xy \, dy = 0$. **(05 Marks)**

c. Solve : $\frac{dy}{dx} + y \cot x = \cos x$. **(05 Marks)**

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