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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks: 100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Employ Taylor's series method to obtain the value of y at x = 0.1 and 0.2 for the differential equation $\frac{dy}{dx} = 2y + 3e^x$, y(0) = 0 considering upto fourth degree term. **(06 Marks)**

b. Determine the value of y when x = 0.1, given that y(0) = 1 and $y'' = x^2 + y^2$ using modified Euler's formula. Take h = 0.05. **(07 Marks)**

c. Apply Adams-Bashforth method to solve the equation $\frac{dy}{dx} = x^2(1+y)$, given y(1) = 1, y(1.1)= 1.233, y(1.2) = 1.548, y(1.3) = 1.979. Evaluate y(1.4). **(07 Marks)**

2 a. Solve $\frac{dy}{dx} = 1 + zx$, $\frac{dz}{dx} = -xy$, y(0) = 0, z(0) = 1 at x = 0.3 by taking h = 0.3. Applying *Runge-Kutta method of fourth* order. **(06 Marks)**

b. Applying Picard's method to compute y(1.1) from the second approximation to the solution of the differential equation $y'' + y^2y' = x^3$. Given that y(1) = 1, y'(1) = 1. **(07 Marks)**

c. Using the Mitni's method obtain an approximate solution at the point x = 0.8 of the problem $\frac{d^2y}{dx^2} = 1 - 2y\frac{dy}{dx}$, give that y(0) = 0, y'(0) = 0, y(0.2) = 0.02, y'(0.2) = 0.1996, y(0.4) = 0.0795, y'(0.4) = 0.3937, y(0.6) = 0.1762, y'(0.6) = 0.5689. **(07 Marks)**

3 a. Derive Cauchy-Riemann equations in Cartesian form. **(06 Marks)**

b. Give u + v $(x - y)(x^2 + 4xy + y^2)$ find the analytic function f(z) = u + iv. **(07 Marks)**

c. If f(z) = u + iv is an analytic function then prove that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$ **(07 Marks)**

4 a. Find the image of the straight lines parallel to coordinate axes in z-plane under the transformation $w = z^2$. **(06 Marks)**

b. Find the bilinear transformation which maps the points z = 1, i, –1 on to the points w = 0, 1, ∞. **(07 Marks)**

c. Evaluate $\int_c \frac{e^{2z}}{(z+1)(z+2)}$, where c is the circle |z| = 3. **(07 Marks)**

PART – B

5 a. Find the solution of the Laplace equation in cylindrical system leading to Besseis differential equation. **(06 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$, then prove that $\int_0^1 x\, J_n(\alpha x)\, J_m(\beta x)\, dx = 0$, $m \neq n$. **(07 Marks)**

c. Express $f(x) = x^4 - 2x^3 + 3x^2 - 4x + 5$ in terms of legendre polynomial. **(07 Marks)**

6 a. A committee consists of 9 students, 2 from first year, 3 from second year and 4 from third year. 3 students are to be removed at random. What is the probability that (i) 3 students belongs to different class (ii) 2 belongs to the same class and third belongs to different class. (iii) All the 3 belongs to the same class. **(06 Marks)**

b. State and prove Bayes theorem. **(07 Marks)**

c. The chance that a doctor will diagnose a disease correctly is 60%. The chance that a patient will die after correct diagnose is 40% and the chance of death after wrong diagnose is 70%. If a patient dies, what is the chance that disease was correctly diagnosed. **(07 Marks)**

7 a. The probability distribution of finite random variable x is given by the following table:

x :	0	1	2	3	4	5	6	7
p(x) :	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Find k, $p(x < 6)$, $p(x \geq 6)$, $p(3 < x \leq 6)$ **(06 Marks)**

b. Obtain the mean and variance of *Poisson* distribution. **(07 Marks)**

c. The life of an electric bulb is normally distributed with average life of 2000 hours and standard deviation of 60 hours. Out of 2500 bulbs, find the number of bulbs that are likely to last between 1900 and 2100 hours. Given that $p(0 < z < 1.67) = 0.4525$. **(07 Marks)**

8 a. Explain the following terms:
i) Null hypothesis (ii) Type I and Type II error (iii) Confidence limits. **(06 Marks)**

b. The weight of workers in a large factory are normally distributed with mean 68 kgs, and standard deviation 3 kgs. If 80 samples consisting of 35 workers each are chosen, how many of 80 samples will have the mean between 67 and 68.25 kgs. Given $p(0 < z \leq 2) = 0.4772$ and $p(0 \leq z \leq 0.5) = 0.1915$. **(07 Marks)**

Eleven students were given a test in statistics. They were provided additional coaching and then a second test of equal difficulty was held at the end of coaching. Marks scored by them in the two tests are given below.

Test I	23	20	19	21	18	20	18	17	23	16	19
Test II	24	19	22	18	20	22	20	20	23	20	17

Do the marks give evidence that the student have benefited by extra coaching? Given $t_{0.05}(10) = 2.228$. Test the hypothesis at 5% level of significance. **(07 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Prove that $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$. **(06 Marks)**

b. If l_1, m_1, n_1 and l_2, m_2, n_2 are direction cosines of two lines then prove that the angle between them is $\cos\theta = l_1l_2 + m_1m_2 + n_1n_2$. **(07 Marks)**

c. Find the equation of the plane through the interaction of the planes $2x + 3y - z = 5$ and $x - 2y - 3z = -8$, also perpendicular to the plane $x + y - z = 2$. **(07 Marks)**

2 a. Prove that the equation of the plane in the intercept form is $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **(06 Marks)**

b. Find the equation of the plane through the points (1, -2, 2) (-3, 1, -2) and perpendicular to the plane $2x - y - z + 6 = 0$. **(07 Marks)**

c. Find the angle between the following lines:

$$\frac{x-2}{3}=\frac{y-1}{1}=\frac{z-3}{2} \quad \text{and} \quad \frac{x+1}{2}=\frac{y-3}{-1}=\frac{z-1}{0}$$ **(07 Marks)**

3 a. Find the sine of the angle between $\vec{a} = 2\vec{i} - 2\vec{j} + \vec{k}$ and $\vec{b} = \vec{i} - 2\vec{j} + 2\vec{k}$. **(06 Marks)**

b. Find the value of λ if the vectors $\vec{a} = 4\vec{i} + 6\vec{j} + 2\vec{k}$, $\vec{b} = 3\vec{i} + 10\vec{j} + 5\vec{k}$ and $\vec{c} = -4\vec{i} + 5\vec{j} + \lambda\vec{k}$ are coplanar. **(07 Marks)**

c. Prove the following:

i) $(3\vec{a} - 2\vec{b}) \times (4\vec{a} + 2\vec{b}) = 14(\vec{a} + \vec{b})$

ii) $(2\vec{a} + 3\vec{b}) \times (\vec{a} + 4\vec{b}) = 5(\vec{a} + \vec{b})$ **(07 Marks)**

4 a. A particle moves along the curve $\vec{r} = (t^3 - 4t)\vec{i} + (t^2 + 4t)\vec{j} + (8t^2 - 3t^3)\vec{k}$. Find the velocity and acceleration at t = 1 and also find their magnitude. **(06 Marks)**

b. Find the unit normal vector to the surface $xy^3z^2 = 4$ at the point (-1, -1, 2). **(07 Marks)**

c. Find the directional derivative of x^2yz^3 at (1, 1, 1) in the direction of $\vec{i} + \vec{j} + 2\vec{k}$. **(07 Marks)**

5 a. Find div $\vec{F}$ and curl $\vec{F}$, where $\vec{F} = x^3\vec{i} + y^3\vec{j} + z^3\vec{k}$. **(06 Marks)**

b. Prove that curl grad $\phi = 0$. **(07 Marks)**

c. Find the constants a, b, c such that the vector $\vec{F} = (x + y + az)\vec{i} + (x + cy + 2z)\vec{k} + (bx + 2y - z)\vec{j}$ is irrotational. **(07 Marks)**

6 Find the Laplace transform of the following:

a. $\sin 4t \cos 3t$

b. cos hat

c. $te^{-t}\sin t$

d. $\frac{1-\cos t}{t}$ **(20 Marks)**

7 Find the inverse Laplace transform of

a. $\log\left(\frac{s+1}{s-1}\right)$ **(06 Marks)**

b. $\frac{s+1}{s^2+2s+2}$ **(07 Marks)**

c. $\frac{s}{(s+1)(s+2)(s-3)}$ **(07 Marks)**

8 a. By applying Laplce transforms, solve the differential equation $\frac{d^5y}{dt^2}+5\frac{dy}{dt}+6y=5e^{2t}$ subjected to the conditions $y(0) = y'(0) = 0$. **(10 Marks)**

b. Solve the simultaneous equations $\frac{dx}{dt}+y=\sin t$, $\frac{dy}{dt}+x=\cos t$ using Laplace transforms. Given that $x = 1$, $y = 0$ when $t = 0$. **(10 Marks)**

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10ME42B/AU42B/TL42

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the following with necessary schematic diagrams:
   i) International prototype meter.
   ii) Imperial standard yard. **(12 Marks)**

   b. Illustrate the process of slip gauge wringing. **(06 Marks)**

   c. What are protector blocks? **(02 Marks)**

2 a. Discuss the following with necessary diagrams:
   i) Compound tolerance
   ii) Accumulation of tolerance. **(08 Marks)**

   b. Illustrate the following types of gauges:
   i) Adjustable snap gauge.
   ii) Double ended solid snap gauge.
   iii) Ring gauge. **(12 Marks)**

3 a. Discuss the construction and working of a pneumatic comparator with a schematic diagram. **(11 Marks)**

   b. List the instruments used for angular measurement. **(03 Marks)**

   c. Select the angle gauges out of the following 13 gauges to build an angle of 57° 34′ 15″ and sketch the combination:
   I series: 1°, 3°, 9°, 27° and 41°
   II series : 1′, 3′, 9′, and 27′
   III series : 3″, 6″, 18″, and 30″. **(06 Marks)**

4 a. Illustrate the 2 methods of measuring minor diameter of internal threads. **(10 Marks)**

   b. List the different methods of measuring the gear tooth thickness. **(02 Marks)**

   c. Illustrate the terms used in connection with gear tooth. **(08 Marks)**

PART – B

5 a. With a schematic diagram, discuss generalized measurement system. **(10 Marks)**

   b. What is calibration? Also, explain the following terms:
   i) Single point calibration
   ii) Multipoint calibration
   iii) Dynamic calibration
   iv) Static calibration. **(10 Marks)**

6 a. Illustrate a ballast circuit. Also, draw the curves showing relation between input and output for a ballast circuit. (10 Marks)

b. Illustrate the cathode ray tube schematically and explain its working. (10 Marks)

7 a. Illustrate the ordinary equal-arm beam balance. Also, explain the method of symmetry used for checking the true null of the above balance. (10 Marks)

b. Illustrate the Pirani thermal conductivity gage. Also, explain the phenomenon on which this gage is based. (10 Marks)

8 a. Illustrate a simple flat strip configuration of a wire RTD. Represent mathematically, the temperature – resistance relation of an RTD for most metals. Also, mention the properties desirable in a material used for RTD elements. (12 Marks)

b. Illustrate a simple resistance-bridge arrangement for strain measurement which uses a dummy gage for temperature compensation. (08 Marks)

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10ME/AU43

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. Use of steam and vapour tables is not permitted

PART – A

1 a. Define the terms: i) Stoichiometric air; ii) Percent excess air; iii) Enthalpy of combustion; iv) Enthalpy of formation; v) Adiabatic flame temperature. **(10 Marks)**

b. The volumetric composition of dry flue gases obtained by the combustion of an unknown hydrocarbon is 12.7% CO_2, 0.9% CO, 3.9% O_2 and 82.5% N_2. Determine:
i) Composition of the fuel; ii) Theoretical air required for complete combustion; iii) Percentage of excess air required. **(10 Marks)**

2 a. With the help of P-V and T-S diagram, derive an equation for theoretical air standard efficiency of a semi diesel (dual) cycle in terms of compression ration, cut off ratio and explosion ratio, with suitable assumptions. **(10 Marks)**

b. In an air standard diesel cycle the compression ratio is 15 and the fluid properties at the beginning of compression are 100 kPa and 300K. For a peak temperature of 1600K calculate i) the percentage of stroke at which cut-off occurs; ii) the cycle efficiency and iii) the work output/kg. **(10 Marks)**

3 a. Describe the following as applied to I.C. engine: i) Morse test; ii) Heat balance sheet. **(08 Marks)**

b. During a test on a single cylinder 4 stroke oil engine the following observations were made Bore = 30cm, stroke = 45cm, duration of trail = 1hr, total fuel consumption = 7.6kg calorific value of fuel = 45,000 kJ/kg, total revolutions made = 12000, mean effective pressure 6 bar, net brake load = 1.47 kN. Brake drum diameter 1.8m rope diameter 3cm. Mass of jacket cooling water circulated = 550kg water enters at 15°C water leaves at 60°C. Total air consumption 360kg room temperature 20°C, exhaust gas temperature = 300°C. Calculate:
i) Indicated and brake power; ii) Indicated thermal efficiency; iii) Mechanical efficiency; iv) Draw the heat balance sheet on minute basis. **(12 Marks)**

4 a. Why carnot cycle is not used as a reference cycle for steam power plant? **(03 Marks)**

b. Sketch the flow diagram and corresponding T – S diagram of a reheat vapour cycle and derive an expression for reheat cycle efficiency. **(07 Marks)**

c. A 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10 kPa. The steam leaves the boiler and enters the steam turbine at 400°C. The isentropic efficiency of steam turbine is 85%. Determine:
i) The cycle efficiency; ii) The quality of exhaust steam from the turbine and iii) Steam flow rate in kg/hr considering pump work.
Properties of steam. **(10 Marks)**

Pressure bar	ts °c	Specific volume m^3/kg		Specific enthalpy kJ/kg			Specific entropy kJ/kg K		
		v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
40	250.3	0.00125	0.049	1087.4	1712.9	2800.3	2.797	3.272	6.069
0.1	45.83	0.0010	14.675	191.8	2392.9	2584.7	0.649	7.502	8.151

PART – B

5 a. State the advantages of multistage compression. **(04 Marks)**

b. Derive the relation among volumetric efficiency, the pressure ratio and index of compression and expansion. Plot the variations of volumetric efficiency with clearance for various pressure ratio. **(08 Marks)**

c. Atmospheric air at 1 bar and 27°C is taken into a single stage reciprocating compressor. It is compressed according to the law $PV^{1.3} = C$, to the delivery pressure of 6 bar. The compressor takes $1m^3$ of air/min. The speed of the compressor is 300 rpm. Stroke to diameter ratio is equal to 1.5:1 mechanical efficiency of the compressor 0.85 motor transmission efficiency 0.9 calculate:

i) The indicated power and isothermal efficiency.

ii) The cylinder dimensions and power of motor required to drive the compressor. **(08 Marks)**

6 a. Discuss with the help of T-S diagrams the three methods of improving the thermal efficiency of an open cycle gas turbine plant. **(12 Marks)**

b. A gas turbine unit has a pressure ratio 6:1 and maximum cycle temperature of 610°C. The isentropic efficiency of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15°C and rate of 16kg/s. Assume $C_p = 1.005$ for $C_p = 1.11$ for $\gamma = 1.4$ compression = expansion = n = 1.33. **(08 Marks)**

7 a. Write a short note on air cycle refrigeration. **(04 Marks)**

b. With the help of neat flow diagram explain the working of steam jet refrigeration system. **(08 Marks)**

c. An ammonia vapour compression refrigerating machine works between 25°C and -20°C. The ammonia leaves the compressor in dry and saturated condition. Liquid ammonia is under cooled to 21.5°C before passing through throttle valve. The average specific heat of liquid ammonia is 4.75 kJ/kg°C. Find the theoretical cop of machine. The following properties of NH_3 are given. If the net refrigeration required is 400×10^3 kJ/hr. Find the mass of ammonia circulated/min. Assume cop actual is 75% of cop theoretical:

Temp °C	Liquid kJ/kg		Vapour kJ/kg K	
	h_f kJ/kg	s_f	h_g	s_g
25	537.6	4.612	1708.5	8.534
-20	328.4	3.854	1661.0	9.118

(08 Marks)

8 a. Derive the equations for relative humidity and specific humidity of moist air. **(04 Marks)**

b. *With neat sketch explain the working of air conditioning system for hot and dry weather.* Present the process involved on a psychrometric chart **(06 Marks)**

c. Calculate: i) relative humidity; ii) humidity ratio; iii) dew point temperature; iv) density and v) Enthalpy of atmospheric air when the DBT is 35°C, WBT = 23°C and the barometer reads 750mm Hg. **(10 Marks)**

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10ME/AU/PM/TL44

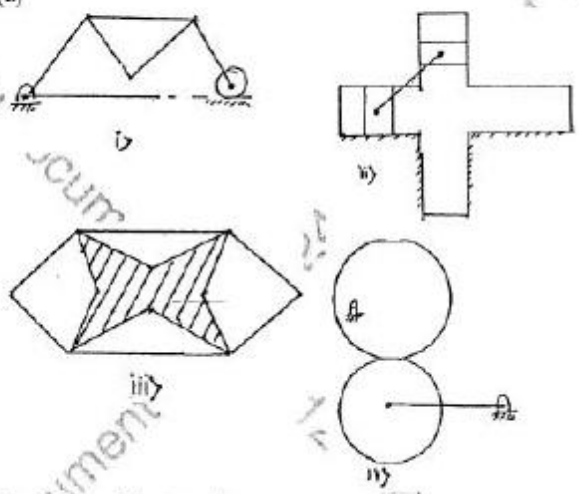
Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Graphical solution may be obtained either on graph or on answer sheet.*

PART – A

1 a. Define degrees of freedom. Find the degrees of freedom for the following mechanism as shown in Fig.Q1 (a) **(10 Marks)**



b. Define the following terms with examples:
i) Kinematic pair ii) Mechanism iii) Structure iv) Inversion **(10 Marks)**

2 a. Describe with neat sketch two inversion of double slider-crank chain mechanism. **(10 Marks)**

b. Derive an expression for necessary condition of correct steering and explain Ackermann steering gear with neat sketch. **(10 Marks)**

3 A four bar mechanism shown in Fig. Q3 crank BC rotates with an angular velocity of 100 rad/sec and an angular acceleration of 4400 rad/sec^2 at the instant when the crank makes an angle 53° to the horizontal. Draw the acceleration polygon and determine the linear acceleration of points E and the angular acceleration of link 3. **(20 Marks)**

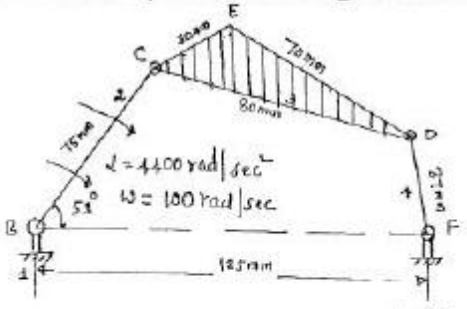


Fig. Q3

4 a. Write a note on Kennedy's theorem. **(05 Marks)**

b. List the properties of instantaneous centre of rotation. **(05 Marks)**

c. In a slider crank mechanism shown in Fig. Q4 (c) the crank OA = 300 mm and connecting rod AB = 1200 mm the crank OA is turned 30° from inner dead centre. Locate all the instantaneous centres. If the crank rotates at 15 rad/sec clockwise, find i) velocity of slider B and ii) Angular velocity of connecting rod AB. **(10 Marks)**

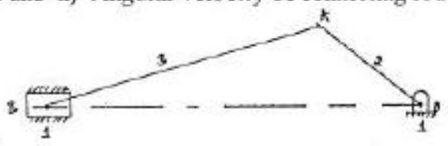


Fig. Q4 (c)

PART – B

5 a. Derive an expression for displacement analysis of a 4 bar mechanism using complex algebra method. **(10 Marks)**

b. For a single slider mechanism, of Fig. Q5 (b) determine the velocity and acceleration of piston, angular acceleration of connecting rod. Take crank length = 50 mm, connecting rod = 200 mm, Crank speed = 300 rpm (constant), Crank angle 30°. **(10 Marks)**

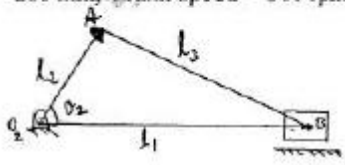


Fig. Q5 (b)

6 a. Derive an equation to determine length of arc of contact for mating of 2 spur gear. **(08 Marks)**

b. Two gear wheel mesh externally and are to give a velocity ratio of 3. The teeth are of involute form of module 6 mm and standard addendum one module. Pressure angle = 18°. Pinion rotates at 90 rpm. Find

i) Number of teeth on each wheel so that interference is just avoided.

ii) Length of path of contact.

iii) Maximum velocity of sliding between teeth.

iv) Number of pairs of teeth in contact. **(12 Marks)**

7 a. Explain with neat sketch classification of gear trains. **(06 Marks)**

b. In an epicyclic gear train, the internal wheels A, B and the compound wheel C and D rotate independently about the axis 'O'. The wheel E and F rotate on a pin fixed to the arm G. E gear with A and C, and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18, C and D are 28, 26 respectively.

i) Sketch the arrangement.

ii) Number of teeth on A and B.

iii) If arm (G) makes 200 rpm clockwise and gear A is fixed, find speed of gear B.

iv) If arm (G) makes 100 rpm clockwise and gear A make 50 rpm CCW, find the speed of gear B. **(14 Marks)**

8 A cam rotating at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below:

i) Outward during 150° with UARM.

ii) Dwell for next 30°

iii) Return during next 120° with SHM.

iv) Remaining dwell period.

Stroke of the follower is 3 cm. Minimum radius of cam is 3 cm. Draw the cam profile when the follower axis is offset to the left by 1 cm and determine maximum velocity and maximum acceleration during outstroke. **(20 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Manufacturing Process – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain with a neat sketch the nomenclature of a single point cutting tool, highlighting the significance of different angles. **(08 Marks)**

b. With necessary sketches, explain the types of Toolwear. **(08 Marks)**

c. Briefly describe the various types of chips produced during metal cutting operations. **(04 Marks)**

2 a. What are the desirable properties or characteristics of an ideal cutting tool material? **(06 Marks)**

b. Briefly explain the desirable properties and purpose of cutting fluids. **(06 Marks)**

c. With a neat sketch, explain different heat affected zones during orthogonal cutting. **(08 Marks)**

3 a. Differentiate between turret lathe and capsten lathe. **(06 Marks)**

b. Explain with the help of a neat sketch, the Whitworth quick return mechanism of a shaper. **(08 Marks)**

c. Compare shaper and planer in terms of their operation, types of workpiece and applications. **(06 Marks)**

4 a. Draw a neat diagram of a radial drilling machine. Name and explain the parts and its principle of operation. **(07 Marks)**

b. Explain with sketches the following operations in a drilling machine:
(i) Reaming (ii) Boring (iii) Counter boring (iv) Trepanning. **(07 Marks)**

c. Describe twist drill nomenclature using sketches. **(06 Marks)**

PART – B

5 a. Differentiate between:
(i) Up milling and down milling ii) Simple indexing and compound indexing **(08 Marks)**

b. With a neat sketch, explain the working of an universal dividing head. **(06 Marks)**

c. Show the calculation for setting dividing head to mill 69 teeth (division) on a spur gear blank by compound indexing. Index plate with circles of holes patented by the Porous and Sharp Manufacturing Company are as follows:
Plate No. 1 – 15, 16, 17, 18, 19, 20
Plate No. 2 – 21, 23, 27, 29, 30, 33
Plate No. 3 – 37, 39, 41, 43, 47, 49 **(06 Marks)**

6 a. With respect to grinding process, differentiate between:
(i) Glazing and loading
(ii) Dressing and truing of wheels
(iii) Cylindrical grinding and centreless grinding. **(12 Marks)**

b. Explain the different factors to be considered in the selection of a grinding wheel. **(08 Marks)**

7 a. *Sketch and explain the process of super finishing.* **(06 Marks)**
b. What is Honing? Explain with sketch. **(06 Marks)**
c. List the operations and application of polishing and buffing. **(08 Marks)**

8 a. Explain briefly with a neat sketch the working principle of a electron beam machining (EBM) and what are its limitations. **(10 Marks)**
b. Briefly describe the principle of electro-discharge machining (EDM) process with a sketch and what are its advantages and disadvantages. **(10 Marks)**

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10ME/AU46B

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define following and mention their units:
(i) Mass density (ii) Dynamic viscosity (iii) Surface tension
(iv) Bulk modulus (v) Capillarity **(10 Marks)**

b. Explain effect of variation of temperature on viscosity of liquid and gases. **(04 Marks)**

c. A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of 15.10cm. Both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12 N-m is required to rotate the inner cylinder at 100 rpm, determine the viscosity of the fluid. **(06 Marks)**

2 a. Define: (i) Gauge pressure (ii) Vacuum pressure (iii) Absolute pressure. **(03 Marks)**

b. A hydraulic press has a ram of 30 cm diameter and a plunger of 5 cm diameter. Find the weight to be lifted by the hydraulic press. When the force applied at the plunger is 400 N. **(03 Marks)**

c. Derive an expression for total pressure and centre of pressure on an inclined plane surface submerged in liquid. **(08 Marks)**

d. A pipe line which is 4 meter in diameter contains a gate valve. The pressure at the centre of pipe is 19.6 N/cm^2. If the pipe is filled with oil of sp.gr. 0.87, find the force exerted upon the gate and position of centre of pressure. **(06 Marks)**

3 a. Define following terms:
(i) Buoyancy (ii) Centre of buoyancy (iii) Meta centre (iv) Meta centric height. **(04 Marks)**

b. Explain the condition for stability of submerged and floating bodies. **(04 Marks)**

c. A cone of specific gravity S, is floating in water with its apex downwards. It has a diameter D and vertical height H. Show that for stable equilibrium of the cone

$$H < \frac{1}{2}\left[\frac{D^2 S^{1/3}}{2 - S^{1/3}}\right]^{1/2}$$ **(12 Marks)**

4 a. Write assumptions made while deriving Euler's equation of motion. **(03 Marks)**

b. Derive Euler's equation of motion. Also derive Bernoulli's equation. **(10 Marks)**

c. A pipe of diameter 400 mm carries water at a velocity of 25 m/sec. The pressures at the points A and B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively, while the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. **(07 Marks)**

PART – B

5 a. Explain: (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity model and prototype. **(06 Marks)**

b. A vertical venturimeter has an area ratio 5. It has a throat diameter of 10 cm. When oil of specific gravity 0.8 flows through it, the mercury in the differential gauge indicates a difference in height of 12 cm. Find the discharge through venturi. Take $\epsilon_d = 0.98$. **(06 Marks)**

c. The functional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$$ **(08 Marks)**

6 a. Derive Darcy Weisbach equation for flow through pipe. **(08 Marks)**

b. What do you mean by hydraulic gradient line and total energy line? **(02 Marks)**

c. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarges to 300 mm. The height of water level in tank is 8 m above the centre of pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe. **(10 Marks)**

7 a. For a fluid flow through a pipe, show that maximum fluid velocity is twice the average velocity. Also derive Hagen Poiseuille's equation. **(12 Marks)**

b. Determine (i) pressure gradient (ii) the shear stress at the two horizontal parallel plates and (iii) the discharge per meter width for the laminar flow of oil with a maximum velocity of 2 m/sec between two horizontal parallel fixed plates which are 100 mm apart. $\mu = 2.4525$ N-s/m^2. **(08 Marks)**

8 a. Explain the terms:
(i) Lift (ii) Drag (iii) Displacement thickness (iv) Momentum thickness. **(08 Marks)**

b. Define the terms sonic flow, subsonic flow and supersonic flow. **(03 Marks)**

c. A flat plate 1.5m × 1.5m moves at 50 kmph in stationary air of density 1.15 kg/m^3. If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine
(i) The lift force, (ii) The drag force, (iii) The resultant force, (iv) Power required to the plate in motion. **(09 Marks)**

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