2 0 1 6

(6th Semester)

MATHEMATICS

Paper : Math–361

(Modern Algebra)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

Answer **one** question from each Unit

UNIT—I

1. *(a)* Prove that the centre Z of a group is a normal subgroup of G. 5

(b) Let G be a group. Prove that the mapping $f : G \quad G$ given by $f(a) \quad a^{1} \quad a \quad G$ is an isomorphism if and only if G is Abelian. 5

2. The set $I(G)$ of all inner automorphisms of a group G is a normal subgroup of $A(G)$, the group of all automorphisms of G. Prove that

$$I(G) \quad G/Z(G)$$

$Z(G)$ is the centre of G. 10

UNIT—II

3. *(a)* Prove that every field is an integral domain. 5

(b) Show that the ring Z_p of integer modulo p is a field if and only if p is a prime. 5

4. *(a)* Prove that the characteristic of an integral domain is either 0 or a prime number. 5

(b) Let R be a commutative ring. Prove that an ideal P of R is a prime ideal if and only if R/P is an integral domain. 5

UNIT—III

5. Prove that every homomorphic image of a ring R is isomorphic to some quotient ring of R. 10

6. *(a)* Prove that in a UFD, every prime element is irreducible. 5

(b) Prove that every Euclidean domain has a unit element. 5

UNIT—IV

7. *(a)* If U and V are two subspaces of a finite dimensional vector space V, then show that

$$\dim(U \quad V) \quad \dim U \quad \dim V \quad \dim(U \quad V)$$ 7

(b) Prove that the set of vectors

$$\{(1, 2, 3), (2, 1, 2), (2, 2, 1)\}$$

is linearly independent in R^3. 3

8. *(a)* If W be a subspace of a finite dimensional vector space $V(F)$, then prove that

$$\dim \frac{V}{W} \quad \dim V \quad \dim W$$ 6

(b) Let $T: R^3 \quad R^3$ be the linear transformation defined by

$$T(x, y, z) \quad (3x, x \quad y, 2x \quad y \quad z)$$

Show that T is a homomorphism. 4

UNIT—V

9. *(a)* Let V and W be vector spaces over the same field F and also let T be a linear transformation from V into W. If V is finite dimensional, then show that

$$\text{rank}(T) + \text{nullity}(T) = \dim V$$ 6

(b) Let $T: R^3 \quad R^3$ be a linear transformation defined by

$$T(x, y, z) \quad (3x \quad z, \quad 2x \quad y, \quad x \quad 2y \quad 4z)$$

Compute the matrix A of T with respect to the standard basis of R^3. 4

10. Let $T: R^3 \quad R^3$ be a linear transformation whose matrix with respect to the standard basis of R^3 is

$$A \quad \begin{matrix} \cos & \sin & 0 \\ \sin & \cos & 0 \\ 0 & 0 & 1 \end{matrix}$$

Find the matrix B of T with respect to the standard basis $\{(1, 0, 0), (1, 1, 0), (1, 1, 1)\}$ of R^3. Also find a non-singular matrix P such that $PAP^{1} \quad B$. 10

★★★

Subject Code : MATH/VI/09

Booklet No. A

To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Subject ....

Paper ....

INSTRUCTIONS TO CANDIDATES

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DEGREE 6th Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Roll No. ....

Regn. No. ....

Subject ....

Paper ....

Descriptive Type
Booklet No. B ....

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/340

2 0 1 6

(6th Semester)

MATHEMATICS

Paper : Math–361

(Modern Algebra)

(PART : A—OBJECTIVE)

(*Marks* : 25)

Answer **all** questions

SECTION—A

(*Marks* : 10)

Each question carries 1 mark

Put a Tick (✓) mark against the correct answer in the brackets provided :

1. Which of the following statements is false?

(a) A subgroup H of a group G is normal if and only if each left coset of H in G is a right coset of H in G ( )

(b) Every subgroup of an Abelian group is normal ( )

(c) If H is a normal subgroup of G and K is a subgroup of G, then H K is a normal subgroup of K ( )

(d) A subgroup H of G is normal if and only if ab H implies that ba H, a, b G ( )

2. If f is a homomorphism of G into G, then K is the kernel of f if

(a) $k \quad \{x \quad G : f(x) \quad e\}$ ( )

(b) $k \quad \{x \quad G : f(x) \quad e\}$ ( )

(c) $k \quad \{x \quad G : f(x) \quad 0\}$ ( )

(d) $k \quad \{x \quad G : f(x) \quad x\}$ ( )

3. The necessary and sufficient conditions for a non-empty subset S of a ring R to be a subring are

(a) $a \quad b \quad S$ and $\frac{a}{b} \quad S$ for all $a, b \quad S$ ( )

(b) $a \quad b \quad S$ and $ab \quad S$ for all $a, b \quad S$ ( )

(c) $a \quad b \quad S$ and $\frac{a}{b} \quad S$ for all $a, b \quad S$ ( )

(d) $a \quad b \quad S$ and $ab \quad S$ for all $a, b \quad S$ ( )

4. The proper ideals of Z_{12} are 2 , 3 , 4 and 6 , then the maximal ideals are

(a) 2 and 4 ( )

(b) 2 and 6 ( )

(c) 2 and 3 ( )

(d) 4 and 6 ( )

5. The units in Z_8 $\{0, 1, 2, 3, 4, 5, 6, 7\}$ modulo 8 are

(a) 0, 2, 4, 6 ( )

(b) 1, 3, 5, 6 ( )

(c) 1, 3, 5, 7 ( )

(d) 4, 5, 6, 7 ( )

6. The associates of a non-zero element $a \quad ib$ of the ring of Gaussian integers $D \quad \{a \quad ib, a, b \quad I\}$ are

(a) $a \quad ib, \quad a \quad ib, \quad b \quad ia, b \quad ia$ ( )

(b) $a \quad ib, \quad a \quad ib, \quad b \quad ia, b \quad ia$ ( )

(c) $a \quad ib, \quad a \quad ib, b \quad ia, b \quad ia$ ( )

(d) $a \quad ib, a \quad ib, \quad a \quad ib, \quad a \quad ib$ ( )

7. Which of the following statements is false?

If A and B are subspaces of V, then

(a) $A \quad B$ is a subspace of V ( )

(b) A is a subspace of $A \quad B$ ( )

(c) B is a subspace of $A \quad B$ ( )

(d) every element of $A \quad B$ can be uniquely written in the form $a \quad b$, where $a \quad A$, $b \quad B$ and $A \quad B \quad \{0\}$ ( )

8. For the vector space $V_3(F)$, which set is not a basis?

(a) (1, 0, 0), (1, 1, 0), (1, 1, 1) ( )

(b) (1, 0, 0), (0, 1, 0), (0, 0, 1) ( )

(c) (1, 0, 0), (0, 1, 0), (1, 1, 1) ( )

(d) (1, 0, 1), (1, 0, 0), (0, 0, 1) ( )

9. If $A \quad \begin{matrix} 0 & 1 \\ 4 & 4 \end{matrix}$, then the eigenvalues of A are

(a) 0, 4 ( )

(b) 2, 2 ( )

(c) 1, 4 ( )

(d) 1, 4 ( )

10. The eigenvalues of a real skew-symmetric matrix are

(a) purely imaginary ( )

(b) all zero ( )

(c) purely imaginary or zero ( )

(d) all real ( )

SECTION—B

(*Marks* : 15)

Each question carries 3 marks

1. If H is a normal subgroup of G and K is a subgroup of G, then prove that $H \quad K$ is a normal subgroup of K.

2. Prove that the centre of a ring R is a subring of R.

3. Show that 1 i is an irreducible element in $Z[i]$.

4. Prove that the intersection of any two subspaces W_1 and W_2 of a vector space is again a subspace of $V(F)$.

5. Prove that similar matrices have the same eigenvalues.

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2016

(6th Semester)

MATHEMATICS

Paper : MATH–362

(Advanced Calculus)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

Answer **one** question from each Unit

UNIT—I

1. *(a)* State and prove Darboux's theorem. 1+4=5

(b) If f is bounded and integrable function on $[a, b]$, then prove that $|f|$ is also integrable on $[a, b]$ and

$$\left|\int_a^b f\,dx\right| \le \int_a^b |f|\,dx$$ 5

2. *(a)* If a bounded function f is integrable on $[a, c]$ and $[c, b]$, where c is a point of $[a, b]$, then prove that f is also integrable on $[a, b]$. 5

(b) Show that the function $f(x) = 3x + 1$ is Riemann integrable on $[1, 2]$ and hence show that

$$\int_1^2 (3x+1)\,dx = \frac{11}{2}$$ 4+1=5

UNIT—II

3. *(a)* Prove that the improper integral

$$\int_a^b f\,dx$$

converges at a if and only if to every $\epsilon > 0$ there corresponds $\delta > 0$ such that

$$\left|\int_{a+\delta_1}^{a+\delta_2} f\,dx\right| < \epsilon, \quad 0 < \delta_1, \delta_2 < \delta$$ 5

(b) Examine the convergence of the following functions : 2½+2½=5

(i) $\displaystyle\int_0^1 \sqrt{\frac{1+x}{1-x}}\,dx$

(ii) $\displaystyle\int_0^\infty \frac{x\tan^{-1}x}{(1+x^4)^{1/3}}\,dx$

4. *(a)* Show that the integral

$$_0\, x^{n\ \ 1} e^{\ \ x}\, dx$$

is convergent if and only if $n\ \ 0$. 5

(b) Prove that every absolutely convergent integral is convergent. 5

UNIT—III

5. *(a)* If $|a|\ \ 1$, then show that

$$_0 \log(1\ \ a\cos x)\, dx \qquad \log \frac{1}{2}\ \ \frac{1}{2}\sqrt{1\ \ a^2}$$ 5

(b) Let $f(x, y)$ be a continuous function of two variables with rectangle $[a, b; c, d]\ \ \mathbb{R}^2$. Then prove that the function defeined by

$$(y)\ \ {}_a^b f(x, y)\, dx$$

is continuous in $[c, d]$. 5

6. *(a)* Let f be a real valued continuous function of two variables on the closed rectangle $[a, b; c, d]$. Prove that

$$_c^d\ a\ {}_a^b f(x, y)\, dx\ \ dy \qquad {}_a^b\ a\ {}_c^d f(x, y)\, dy\ \ dx$$ 5

(b) Examine the uniform convergence of the convergent improper integral

$$_0\, e^{\ \ x^2} \cos yx\, dx \text{ in } (\ \ ,\ \ )$$ 5

UNIT—IV

7. *(a)* Show that

$$_C \frac{y\,dx\ \ x\,dy}{x^2\ \ y^2}\ \ 2$$

round the circle $C: x^2\ \ y^2\ \ 1$. 5

(b) Show that

$$_0^1\ {}_0^1 \frac{x\ \ y}{(x\ \ y)^3}\, dy\ \ dx \qquad {}_0^1\ {}_0^1 \frac{x\ \ y}{(x\ \ y)^3}\, dx\ \ dy$$ 5

8. *(a)* Change the order of integration in the double integral

$$_0^{2a}\ {}_{\sqrt{2ax\ \ x^2}}^{\sqrt{2ax}} f(x, y)\, dy\, dx$$ 5

(b) With the help of Green's theorem, compute the difference between the line integrals

$$I_1\ \ {}_{ACB} (x\ \ y)^2 dx\ \ (x\ \ y)^2 dy$$

and $$I_2\ \ {}_{ADB} (x\ \ y)^2 dx\ \ (x\ \ y)^2 dy$$

where ACB and ADB are respectively the straight line and the parabolic arc $y\ \ x^2$ joining the points $A(0, 0)$ and $B(1, 1)$. 5

UNIT—V

9. *(a)* If a sequence $\{f_n\}$ converges uniformly to f on $x \in [a, b]$ and let f_n be integrable $\forall\, n$, then prove that f is integrable and

$$\int_a^x f(x)\,dx = \lim_{n\to\infty} \int_a^x f_n(x)\,dx$$ 6

(b) Show that the sequence of function

$$f_n(x) = \frac{nx}{e^{nx^2}}$$

is pointwise, but not uniformly convergent on $[0, \infty[$. 4

10. *(a)* State and prove Cauchy's criterion of uniform convergence of a sequence $\{f_n\}$ of real valued functions on a set E. 6

(b) Examine whether the infinite series

$$\sum_{n=1}^{\infty} \frac{1}{n^3(1 + nx^2)}$$

can be differentiated term by term. 4

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Subject Code : MATH/VI/10

Booklet No. A

Date Stamp ....

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DEGREE 6th Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Subject ....
Paper ....

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DEGREE 6th Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Roll No. ....
Regn. No. ....

Subject ....
Paper ....

Descriptive Type
Booklet No. B ....

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Signature of Examiner(s)

Signature of Invigilator(s)

MATH/VI/10

2 0 1 6

(6th Semester)

MATHEMATICS

Paper : MATH–362

(Advanced Calculus)

(PART : A—OBJECTIVE)

(*Marks* : 25)

Answer **all** questions

SECTION—I

(*Marks* : 10)

Each question carries 1 mark

Put a Tick ☑ mark against the correct alternative in the box provided :

1. The lower Riemann integral for a function f corresponding to the partition P of interval $[a, b]$ is given by the relation

(a) $\sup L(P, f) \quad {}_a^b f\, dx$ ☐

(b) $L(P, f) \quad \sup \quad {}_a^b f\, dx$ ☐

(c) $L(P, f) \quad \inf \quad {}_a^b f\, dx$ ☐

(d) $\sup U(P, f) \quad {}_a^b f\, dx$ ☐

2. If P and P are two partitions of $[a, b]$ such that P is finer than P, then for a bounded function f

(a) $L(P \;, f) \quad L(P, f)$ ☐

(b) $U(P \;, f) \quad U(P, f)$ ☐

(c) $L(P \;, f) \quad L(P, f)$ ☐

(d) $U(P \;, f) \quad U(P, f)$ ☐

3. If f and g be two positive functions on $[a, b]$ such that

$$\lim_{x \quad a} \frac{f(x)}{g(x)} \quad l$$

a non-zero finite number, then

(a) $_a^b g\,dx$ converges if $_a^b f\,dx$ converges ☐

(b) $_a^b f\,dx$ converges if $_a^b g\,dx$ converges ☐

(c) $_a^b f\,dx$ diverges if $_a^b g\,dx$ diverges ☐

(d) $_a^b f\,dx$ and $_a^b g\,dx$ behave alike ☐

4. The improper integral $_a^b \frac{dx}{(x \quad a)^n}$ converges if and only if

(a) $n \quad 1$ ☐

(b) $n \quad 1$ ☐

(c) $n \quad 1$ ☐

(d) $n \quad 1$ ☐

5. The value of the improper integral $_{0}\, e^{\ x^{2}} \cos\ x\,dx$ is

(a) $\frac{\sqrt{\ }}{2}$ ☐

(b) $\frac{\sqrt{\ }}{2}\, e^{\ /4}$ ☐

(c) $\frac{\sqrt{\ }}{2}\, e^{\ 2/4}$ ☐

(d) $\frac{\ }{\sqrt{2}}\, e^{\ 2/4}$ ☐

6. The uniformly convergent improper integral of a continuous function

(a) is not continuous ☐

(b) is itself continuous ☐

(c) may be continuous ☐

(d) None of the above ☐

7. The value of the integral $_{C}\, xy\,dx$ along the arc of the parabola $x \quad y^2$ from (1, 1) to (1, 1) is

(a) 0 ☐

(b) $\frac{2}{5}$ ☐

(c) $\frac{4}{5}$ ☐

(d) $\frac{5}{4}$ ☐

8. The value of the double integral $\quad x^2y^3dx\,dy$ over the circle $x^2 \quad y^2 \quad a^2$ is

(a) 0 ☐

(b) $\frac{1}{2}$ ☐

(c) $\frac{\ }{2}$ ☐

(d) $\frac{1}{2}$ ☐

9. With regards to uniform and pointwise convergence of sequences in $[a, b]$, which of the following is true?

(a) Pointwise convergence   Uniform convergence ☐

(b) Uniform convergence   Pointwise convergence ☐

(c) Uniform limit = Pointwise limit ☐

(d) All of the above ☐

10. The sequence $f_n(x) \quad \frac{n}{x \quad n}$ is

(a) uniformly convergent in $[0, k]$, whatever k may be ☐

(b) only pointwise convergent in $[0, k]$, whatever k may be ☐

(c) not uniformly convergent in $[0, k]$, whatever k may be ☐

(d) uniformly convergent in $[0, \quad)$ ☐

SECTION—II

(*Marks* : 15)

Each question carries 3 marks

1. For any two partitions P_1, P_2 of a bounded function f, show that $L(P_1, f) \quad U(P_2, f)$.

2. Using Frullani's integral, evaluate

$$_0 \frac{e^{\quad ax} \qquad e^{\quad bx}}{x}\, dx$$

3. State Weierstrass' M-test for the uniform convergence of a convergent improper integral.

4. Evaluate $_C(x^2 \quad y^2)\,dx$, where C is the arc of the parabola $y^2 \quad 4ax$ between (0, 0) and $(a,\ 2a)$.

5. Show that $f_n(x) \quad \dfrac{nx}{1 \quad n^2 x^2}$ is not uniformly convergent in any interval containing zero.

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2 0 1 6

(6th Semester)

MATHEMATICS

Paper : Math–363

(Mechanics)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

Answer **five** questions taking **one** from each Unit

UNIT—I

1. *(a)* A heavy uniform rod rests in a limiting equilibrium within a fixed rough hollow sphere. If   be the angle of friction and 2   the angle subtended by the rod at the centre of the sphere, then show that the inclination   of the rod to the horizon is given by

$$2\tan \quad \tan(\quad) \quad \tan(\quad)$$ 5

(b) The moment of a system of coplanar forces (not in equilibrium) about three collinear points A, B, C in the plane are G_1, G_2, G_3. Prove that

$$G_1 \ BC \quad G_2 \ CA \quad G_3 \ AB \quad 0$$ 5

2. *(a)* If a system of forces in one plane reduces to a couple whose moment is G and when each force is turned round its point of application through a right angle it reduces to a couple of moment H, then prove that when each force is turned through an angle   , the system is equivalent to a couple whose moment is $G\cos \quad H\sin$. For what values of   will the moment of the new couple be equal to the moment of the old couple? 5+2=7

(b) How high can a particle rest inside a rough hollow sphere of radius a, if the coefficient of friction be $\frac{1}{\sqrt{3}}$? 3

UNIT—II

3. *(a)* State and prove parallel axes theorems on moments of inertia. 5

(b) Let AB and AC are two uniform rods of length $2a$ and $2b$ respectively. If BAC , then prove that the distance from A of the centre of gravity of the two rods is

$$\frac{(a^4 \quad 2a^2b^2\cos \quad b^4)^{1/2}}{a \quad b}$$ 5

4. *(a)* A thin uniform wire is bent into a ABC. Prove that its centre of gravity is the same as that of the three weights

$$\frac{b \quad c}{2}, \frac{c \quad a}{2}, \frac{a \quad b}{2}$$

placed at A, B, C respectively. Where a, b and c are the lengths of the sides BC, CA and AB. 5

(b) A uniform circular lamina of radius $3a$ and centre O has a hole in the form of equilateral triangle of side $2a$ with one vertex at O. Prove that the centre of gravity from O is $\frac{2a}{9 \quad \sqrt{3}}$. 5

UNIT—III

5. *(a)* For a particle moving in a plane curve, show that the tangential and normal components of accelerations are

$$v\frac{dv}{ds} \text{ and } \frac{v^2}{\quad}$$

where is the radius of curvature. 5

(b) A particle P moves in the curve $y \quad a \log \sec \frac{x}{a}$ in such a way that the tangent to the curve at P rotates uniformly. Prove that the resultant acceleration of the particle varies as the square of the radius of curvature. 5

6. *(a)* For $\frac{1}{m}$ of the distance between two stations, a train is uniformly accelerated and for $\frac{1}{n}$ of the distance, it is uniformly retarded. It starts from rest at one station and comes to rest at the other. Prove that the ratio of its greatest velocity to its average velocity is

$$1 \quad \frac{1}{m} \quad \frac{1}{n} \quad : 1$$ 5

(b) A particle is moving with SHM and while making an excursion from one position of rest to the other, its distances from the middle point of its path at three consecutive seconds are observed to be x_1, x_2, x_3. Prove that the time of complete oscillation is

$$\frac{2}{\cos^{\ 1} \frac{x_1 \quad x_3}{2x_2}}$$ 5

UNIT—IV

7. *(a)* A projectile aimed at mark which in the horizontal plane through the point of projection, falls a metre short of it when the elevation is and goes b metre far when the elevation is . Show that if the velocity of projection be the same in all the cases, the proper elevation is

$$\frac{1}{2}\sin^{\;1}\frac{a\sin 2\quad b\sin 2}{a\quad b}$$ 5

(b) A particle is projected from a point on the ground level and its height is h when it is at a horizontal distance a and $2a$ from its point of projection. Prove that the velocity of projection u is given by

$$u^2\quad\frac{g}{4}\;\frac{4a^2}{h}\quad 9h$$ 5

8. (a) If r and r are the maximum ranges up and down the inclined plane respectively, prove that

$$\frac{1}{r}\quad\frac{1}{r}$$

is independent of the inclination of the plane. Also show that

$$\frac{1}{r}\quad\frac{1}{r}\quad\frac{2}{R}$$

where R is the maximum range on a horizontal plane with the same velocity of projection. 5

(b) A particle, projected vertically upwards with a velocity U in a medium whose resistance varies as the square of the velocity, will return to the point of projection with velocity $v\quad\frac{UV}{\sqrt{U^2\quad V^2}}$ after a time

$$\frac{V}{g}\quad\tan^{\;1}\frac{U}{V}\quad\tanh^{\;1}\frac{v}{V}$$

where V is the terminal velocity. Prove it. 5

UNIT—V

9. (a) Deduce the work-energy equation. 5

(b) A uniform elastic string has the length a_1 when the tension is T_1 and the length a_2 when the tension is T_2. Show that its natural length is

$$\frac{a_2T_1\quad a_1T_2}{T_1\quad T_2}$$

and the amount of work done in stretching it from its natural length to a length $a_1\quad a_2$ is

$$\frac{1}{2}\frac{(a_1T_1\quad a_2T_2)^2}{(T_1\quad T_2)(a_1\quad a_2)}$$ 5

10. *(a)* Two spheres of masses M, m impinge directly when moving in opposite directions with velocities u and v respectively. If the sphere of mass m is brought to rest by the collision, show that

$$v(m - eM) = M(1 + e)u$$ 5

(b) A smooth billiard ball impinges obliquely on another equal ball at rest in a direction making an angle α with the line of centres at the moment of impact. If the coefficient of restitution of the two balls is $\frac{1}{3}$, prove that the angle through which the direction of motion of the impinging ball deviates is

$$\tan^{-1}\left(\frac{2\tan\alpha}{1 + 3\tan^2\alpha}\right)$$ 5

★★★

Subject Code : MATH/VI/11

Booklet No. A

Date Stamp ....

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To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Subject ....
Paper ....

To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Roll No. ....
Regn. No. ....

Subject ....
Paper ....

Descriptive Type
Booklet No. B ....

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/342

2 0 1 6

(6th Semester)

MATHEMATICS

Paper : Math–363

(Mechanics)

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 10)

Put a Tick ☑ mark against the correct answer in the box provided : 1×10=10

1. The least force P required to pull a body up on an inclined plane inclined at an angle to the horizontal is

(a) $P \quad W\sin(\quad)$ ☐

(b) $P \quad W\sin(\quad)$ ☐

(c) $P \quad W\cos(\quad)$ ☐

(d) $P \quad W\cos(\quad)$ ☐

2. A system of forces in a plane is in equilibrium, if the algebraic sums of the

(a) resolved parts in any two parallel directions vanish ☐

(b) moments of all the forces w.r.t. each of three collinear points are zero ☐

(c) moments about each of the two given points not vanish ☐

(d) resolved parts in any two perpendicular directions vanish ☐

3. Let $(\bar{x}, \bar{y}, \bar{z})$ be the centre of mass of a system of particles with respect to the x, y and z-axes and let parallel x , y , z axes be taken through $(\bar{x}, \bar{y}, \bar{z})$. If F and F be the products of inertia with respect to the x, y axes and with respect to x , y axes, then

(a) $F \quad M\bar{x}\bar{z} \quad F$ ☐

(b) $F \quad M\bar{y}^2 \quad F$ ☐

(c) $F \quad M\bar{x}\bar{y} \quad F$ ☐

(d) $F \quad M\bar{z}^2 \quad F$ ☐

4. The CG of a uniform semi-circular lamina of radius r lies on the axis of its symmetry at a distance from the centre

(a) $\frac{2r}{\ }$ ☐

(b) $\frac{2\sqrt{2}r}{\ }$ ☐

(c) $\frac{\ }{2\sqrt{2}r}$ ☐

(d) $\frac{\ }{2r}$ ☐

5. If the position of a moving particle at time t referred to rectangular axes is given by $x \quad at$, $y \quad bt \quad ct^2$, where a, b and c are constants, then its acceleration at time t is

(a) a along the x-axis ☐

(b) $a \quad b \quad c$ along the x-axis ☐

(c) $2c$ along y-axis ☐

(d) $\sqrt{a^2 \quad b^2}$ along the y-axis ☐

6. The equation of SHM of period T of a particle is

(a) $x \quad T^2 x$ ☐

(b) $x \quad \frac{4 \quad ^2}{T^2} x$ ☐

(c) $x \quad \frac{4T^2}{\quad ^2} x$ ☐

(d) $x \quad \frac{1}{T^2} x$ ☐

7. The least velocity with which a body can be projected to have a horizontal range R is

(a) $\sqrt{gR}$ ☐

(b) $\sqrt{g / R}$ ☐

(c) $\sqrt{R / g}$ ☐

(d) $R\sqrt{g}$ ☐

8. A particle of mass m is let fall from a height h in a medium whose resistance is mk (velocity)^2. The terminal velocity of the particle is given by

(a) $\sqrt{h / g}$ ☐

(b) $\sqrt{g / h}$ ☐

(c) $\sqrt{k / g}$ ☐

(d) $\sqrt{g / k}$ ☐

9. A smooth ball falling vertically from a height x impinges on a horizontal fixed plane. If e is the coefficient of restitution, then the ball rebounds to a height

(a) e^2x ☐

(b) ex ☐

(c) e / x ☐

(d) x / e ☐

10. A smooth sphere impinges directly with velocity u on another smooth sphere of equal mass at rest. If the spheres are perfectly elastic, then the velocity of second sphere after collision will be

(a) 0 ☐

(b) u ☐

(c) $\frac{u}{2}$ ☐

(d) None of the above ☐

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. Forces proportional to 1, 2, 3 and 4 act along the sides *AB*, *BC*, *AD* and *DC* respectively of a square *ABCD* the length of whose sides is 2 ft. Find the magnitude and the line of action of their resultant.

2. Find the centre of gravity of a sectoral area of a circle bounded by the curve r f ( ) and the radius vector and .

3. The maximum velocity of a body moving with SHM is 2 cm/sec and its period is 1/5 sec. What is its amplitude?

4. If h and h be the greatest heights in the two paths of a projectile with a given velocity for a given range R, then show that

$$R \quad 4\sqrt{hh}$$

5. A ball of mass 4 kg moving with a velocity 100 cm/sec overtakes a ball of mass 6 kg moving with velocity 50 cm/sec in the same direction. If $e \quad \frac{1}{2}$, then find the velocities of the balls after impact.

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2016

(6th Semester)

MATHEMATICS

Paper No. : MATH–364 (A)

(Computer Programming in C)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* Write a flowchart of executing a C program. 5

(b) What is an expression? Give one example of C expression. 2

Or

Differentiate between constants and variables. Write brief notes on *(a)* logical constants and *(b)* string constants. 7

2. *(a)* Explain while loop with flowchart or program. 5

(b) Differentiate between getchar( ) and putchar( ). 2

Or

Write the syntax of switch. Write a program using switch and explain in brief. 7

3. What is an array? Write a program to find average mark obtained by a class of 30 students in a test using array. 7

Or

Explain any five string handling functions. 7

4. What is 'function returning pointer'? Write a program to illustrate it. 7

Or

What is a union? Illustrate it with an example. 7

5. List all possible modes in which a file can be opened. Explain. 7

Or

Write the different types of operation that may be carried out on a file. Illustrate it with a program. 7

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Subject Code : MATH/VI/12 (a)

Booklet No. A

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2 0 1 6

(6th Semester)

MATHEMATICS

Paper No. : MATH–364 (A)

(Computer Programming in C)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 10)

1. Put a Tick (✓) mark against the correct answer in the brackets provided : 1×10=10

(a) Every C program must contain a/an

(i) prinf( ) function ( )

(ii) scanf( ) function ( )

(iii) exit( ) function ( )

(iv) main( ) function ( )

(b) The number of keywords available in C is

(i) 30 (   )

(ii) 32 (   )

(iii) 14 (   )

(iv) 28 (   )

(c) The break statement is used to exit from

(i) an if statement (   )

(ii) a for loop (   )

(iii) a program (   )

(iv) the main( ) function (   )

(d) An array is a collection of

(i) different data types scattered throughout the memory ( )

(ii) the same data type scattered throughout the memory ( )

(iii) the same data type placed next to each other in memory ( )

(iv) different data types placed next to each other in memory ( )

(e) What will be the output if you execute the following C code?

```
# include  <stdio.h>
  void main  ()
{
  char i = 13;
  while (i)
  {
    i++;
   }
    printf ("%d", i);
}
```

(i) 0 ( )

(ii) 1 ( )

(iii) 2 ( )

(iv) 3 ( )

(f) File manipulation functions in C are available in which of the following header files?

(i) streams.h ( )

(ii) stdio.h ( )

(iii) stdlib.h ( )

(iv) files.h ( )

(g) Which of the following is valid string function?

(i) strpbrk ( )

(ii) strlen ( )

(iii) strxfrm ( )

(iv) strcut ( )

(h) A multidimensional array can be expressed in terms of

(i) array of pointers rather than as pointers to a group of contiguous array ( )

(ii) array without the group of contiguous array ( )

(iii) data type arrays ( )

(iv) None of the above ( )

(i) Continue statement is used

(i) to go to the next iteration in a loop ( )

(ii) to come out of a loop ( )

(iii) to exit and return to the main function ( )

(iv) to restart iteration from the beginning of a loop ( )

(j) Which of the following is character-oriented console I/O function?

(i) getchar( ) and putchar( ) ( )

(ii) gets( ) and puts( ) ( )

(iii) scanf( ) and printf( ) ( )

(iv) fgets( ) and fputs( ) ( )

SECTION—B

(*Marks* : 10)

2. Answer the following questions : 2×5=10

(a) What is unary operator?

(b) State two advantages of function.

(c) What is 'call by value'?

(d) Differentiate between union and structure.

(e) Write a program to find the largest of two numbers.

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2016

(6th Semester)

MATHEMATICS

Paper : MATH–364 (B)

(Computer Programming in FORTRAN)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* What do you mean by an algorithm? Write an algorithm to find the HCF of two positive integers. 1+3=4

(b) Pick the incorrect real variable names from the following, stating reasons : 3

(i) CONSTANT	*(ii)* VARIAB	*(iii)* NUMBER
(iv) INKPOT	*(v)* ROL.NO	*(vi)* RS-PS
(vii) LAXME	*(viii)* SQRTX	*(ix)* LIMITED
(x) KASAUTI	*(xi)* IXON	*(xii)* BSC

2. *(a)* Which of the following FORTRAN constants are of integer types, real types or not valid (with reasons)? 4

(i) 4505	*(ii)* –8213	*(iii)* 110.52
(iv) +9323	*(v)* 1,00,000	*(vi)* 9E2
(vii) 7.2.4	*(viii)* 80–	*(ix)* 1.01E–02

(b) Write a flowchart to find the largest of three integers. 3

UNIT—II

3. *(a)* Write the general form of DATA statement. Write the DATA statement which will assign

A = 3.5, B = 1.23, C = 34.2 and I = 324 3

(b) If I = 2, J = 3, K = 6, what values the following logical expressions have? 2+2=4

(i) NOT.I.GT.J.AND..NOT.I J.LE.K

(ii) I.GT.J.AND.(I.LE.K.OR.I J.LE.K)

4. *(a)* Consider the following program segment :

```
LOGICAL A,B
Y=12.6
A=112.GT.Y
B=Y.GE.12.6
```

What will be the final value of the logical variables A and B? 1+1=2 *(b)* Consider the following program segment :

```
COMPLEX A,B
A=(3.5,1.2)
B=3  A+A
```

What will be the final value of B? 3

(c) What will be the output of the following program? 2

```
      DATA  I,J,K/34,21,12/
      WRITE(  ,11) I,J,K
11    FORMAT(1X, I4, I4 / 1X, I4)
```

UNIT—III

5. *(a)* Write the general form of arithmetic IF statement. 1

(b) Write a program segment using arithmetic IF statement to do the following : 2

If a b, compute $\sqrt{a^2 \quad b^2}$ and store the result in W

(c) N is said to be a prime number if its only divisors are 1 and itself. Write a FORTRAN program using 'DO loop' that reads an integer N > 2 and determines if N is a prime by testing if N is divisible by any of the integers 2, 3,...N/2. 4

6. *(a)* Write a program to find the sum of digits of an integer. 4

(b) What will be the final value of NNNN in the following program? 3

```
      NNNN = 10
      KKKK = 20
      IF(2  NNNN.LE.KKKK)GO TO 10
      NNNN = NNNN + KKKK
      GO TO 20
10    NNNN = KKKK+5
20    NNNN = NNNN  KKKK
```

UNIT—IV

7. *(a)* Which of the following are invalid subscripted variables? State the reasons : 3

(i) B(J)	*(ii)* A(2J)	*(iii)* JINK(I,J)
(iv) AT(J–2, K+2)	*(v)* INK(I.J)	*(vi)* J(–5)
(vii) KAMB(2 J, 3, I–2)	*(viii)* TEMP(I(J))	

(b) Write a program to arrange numbers in decending orders. 4

8. *(a)* Which of the following are invalid DIMENSION statements? State the reasons : 3

(i) DIMENSION BAL(10,10)

(ii) DIMENSION A(M,N), B(K)

(iii) DIMENSION, BAL(10,10), NUMR((5)

(iv) DIMENSION A(20), C(20)

(v) DIMENSION A(20), C(20).

(vi) COST(5,10,6)

(b) Use a DO loop to write a program which will find the total number of even integers in a given set of 500 integers. 4

UNIT—V

9. Write a FUNCTION subprogram which calculates the area of a triangle in terms of its three sides a, b, c. Also write a main program to use this subprogram. Can the same thing be done by using an arithmetic statement function too? If so, how? 3+2+2=7

10. Write a subroutine to solve the quadratic equation $ax^2 \quad bx \quad c \quad 0$. Also write the main program for this subroutine. 4+3=7

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2016

(6th Semester)

MATHEMATICS

Paper : MATH–364 (B)

(Computer Programming in FORTRAN)

(PART : A—OBJECTIVE)

(*Marks* : 20)

Answer **all** questions

SECTION—A

(*Marks* : 5)

Each question carries 1 mark

Put a Tick ☑ mark against the correct answer in the box provided :

1. In a flowchart, a rectangle with rounded sides is used for

(a) input/output ☐

(b) processing ☐

(c) decision ☐

(d) start/end ☐

2. The final value of B in the following program is

```
B = 25.1
B = B   2
KB = B
B = KB
B = (B + KB)/10
```

(a) 10 ☐

(b) 10. ☐

(c) 5 ☐

(d) 5. ☐

3. Which one is invalid DO statement?

(a) DO 34 K = 1, 20 ☐

(b) DO 22 I = 1, M, N + 3 ☐

(c) DO 65 KAL = MIN, MAX, JACK ☐

(d) DO 35 I = 2.10 ☐

4. Consider the following program segment :

```
          DO 20 I = 1, 10
                DO 10 J = 1, 20
                      READ( , ) B(I,J)
20              CONTINUE
10    CONTINUE
```

This can be written using implied DO notation as

(a) READ(,) (B(I,J),J=1,20),I=1,10) ☐

(b) READ(,) (B(I,J),I=1,20),J=1,10) ☐

(c) READ(,) (B(I,J),I=1,10),J=1,20) ☐

(d) READ(,) (B(I,J),J=1,10),I=1,20) ☐

5. If I 4, J 5, A 4.5 and B 2.5, then the value of A I/J A I B J is

(a) 30 ☐

(b) 30.5 ☐

(c) 30. ☐

(d) 30.51 ☐

SECTION—B

(*Marks* : 15)

Each question carries 3 marks

1. Convert the following algebraic expression into FORTRAN expressions :

$$\frac{\frac{x}{y} \quad 6}{a \quad \frac{x^2}{y^2}}$$

2. Write any two library functions in FORTRAN with simple illustration.

3. Write the general form of computed GOTO statement.

4. Write a FORTRAN program to evaluate the following function :

$$f(x) \quad \begin{matrix} \sin x, \text{ if } x \quad 1 \\ e^{x^2}, \text{ if } x \quad 1 \end{matrix}$$

5. Write the arithmetic statement function to find the area of a circle.

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2 0 1 6

(6th Semester)

MATHEMATICS

Paper : MATH–364 (C)

(Astronomy)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

Answer **one** question from each Unit

UNIT—I

1. *(a)* In a spherical triangle *ABC*, prove that

$$\cos A \quad \frac{\cos a \quad \cos b \cos c}{\sin b \sin c}$$ 5

(b) If *A* and *A* be the angles of an equilateral triangle and its polar respectively, prove that

$$\cos A \quad \cos A \quad \cos A \cos A$$ 5

2. *(a)* If the angles of a spherical triangle be together equal to four right angles, prove that

$$\cos^2 \frac{a}{2} \quad \cos^2 \frac{b}{2} \quad \cos^2 \frac{c}{2} \quad 1$$ 5

(b) If *D* be the middle point of *AB* of a spherical triangle *ABC*, show that

$$\cos a \quad \cos b \quad 2 \cos \frac{c}{2} \cos CD$$ 5

UNIT—II

3. *(a)* If the declination of a star is greater than the latitude , prove that the star's greatest azimuth east or west is

$$\sin^{\ 1}(\cos \quad \sec \ )$$ 5

(b) Find the condition that twilight may last all night. 5

4. Two stars $(\ _1, \ _1)$ and $(\ _2, \ _2)$ have the same longitude. Prove that

$$\sin(\ _1 \quad _2) \quad \tan \ (\cos \ _1 \tan \ _2 \quad \cos \ _2 \tan \ _1)$$

where be the obliquity of the ecliptic. 10

UNIT—III

5. Derive Cassini's formula for atmospheric refraction. 10

6. Find the effect of parallax on longitude and latitude of a star. Hence show that the path of the star described on account of parallax is ellipse. 10

UNIT—IV

7. *(a)* Find the relation between synodic period and orbital period. 5

(b) If be the geocentric distance of a planet, show that the brightness of the planet is given by

$$\frac{C(\quad^2 \quad 2\ b \quad b^2 \quad a^2)}{2b \quad ^2}$$

where C is a constant, a and b are the heliocentric distances of the earth and the planet. 5

8. If and are the velocities of two planets in circular and coplanar orbits, show that the period of direct motion is to the period of retrograde motion as 180 : , where

$$\cos \quad \frac{\qquad}{2 \qquad 2}$$ 10

UNIT—V

9. Deduce the law of gravitation from Kepler's law of planetary motion. 10

10. Find the effect of the dip of the horizon on the times of rising and setting of a star. 10

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Subject Code : MATH/VI/12 (c)

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2016

(6th Semester)

MATHEMATICS

Paper : MATH–364 (C)

(Astronomy)

(PART : A—OBJECTIVE)

(*Marks* : 25)

Answer **all** questions

SECTION—A

(*Marks* : 10)

Each question carries 1 mark

Put a Tick ☑ mark against the correct answer in the box provided :

1. Which of the following statements is not true?

(a) The section of a sphere by a plane is a circle ☐

(b) The sides and angles of a polar triangle are respectively supplements of the angles and sides of primitive triangle ☐

(c) The sides and angles of a polar triangle are respectively supplements of the sides and angles of primitive triangle ☐

(d) If the plane cutting the sphere passes through the centre of the sphere, then the corresponding section is called a great circle ☐

2. In any spherical triangle *ABC* if $A \quad \frac{\ }{2}$, then

(a) $\sin b \quad \sin a \cos b$ ☐

(b) $\sin b \quad \sin a \sin B$ ☐

(c) $\sin b \quad \sin a \cos B$ ☐

(d) $\sin b \quad \cos a \sin B$ ☐

3. The angular distance of the star from the horizon measured along the vertical circle through the star is called

(a) azimuth of the star ☐

(b) altitude of the star ☐

(c) zenith distance of the star ☐

(d) latitude of the star ☐

4. A star whose declination is   will not set or rise at the place of latitude , when

(a) 90 ☐

(b) 90 ☐

(c) ☐

(d) 90 ☐

5. The position of the body will not be affected by refraction when the observed zenith distance is equal to

(a) 0° ☐ *(b)* 45° ☐

(c) 60° ☐ *(d)* 90° ☐

6. The angle between real direction of the star and the direction of the earth's motion is called

(a) parallax ☐

(b) aberration ☐

(c) earth's way ☐

(d) None of the above ☐

7. If the line joining of two planets of radii a and b to one another subtends an angle   at the sun and planets appear to each other to be stationary, then cos   is equal to

(a) $\frac{\sqrt{ab}}{a \quad \sqrt{ab} \quad b}$ ☐

(b) $\frac{\sqrt{ab}}{\sqrt{a} \quad ab \quad \sqrt{b}}$ ☐

(c) $\frac{\sqrt{ab}}{a \quad \sqrt{ab} \quad b}$ ☐

(d) $\frac{\sqrt{ab}}{\sqrt{a} \quad ab \quad \sqrt{b}}$ ☐

8. If d be the elongation of the earth from the sun as seen from a planet, then the phase of the planet is

(a) $\frac{1 \quad \sin d}{2}$ ☐

(b) $\frac{1 \quad \sin d}{2}$ ☐

(c) $\frac{1 \quad \cos d}{2}$ ☐

(d) $\frac{1 \quad \cos d}{2}$ ☐

9. The planets which revolve outside the earth's orbit are called

(a) inferior planets ☐

(b) superior planets ☐

(c) satellites ☐

(d) None of the above ☐

10. The distance of the planet from the sun is called

(a) heliocentric distance ☐

(b) geocentric distance ☐

(c) astronomical unit of distance ☐

(d) None of the above ☐

SECTION—B

(*Marks* : 15)

Each question carries 3 marks

1. In a spherical triangle *ABC*, $C \quad \frac{}{2}$, then prove that

$$\sin b \quad \tan a \cot A$$

2. Given the observer's latitude , the declination and the hour angle H of a star, show that its altitude a can be calculated from the formula

$$\sin a \quad \sin \quad \sin \qquad \cos \quad \cos \quad \cos H$$

3. Given the right ascension of the true sun , the sun's mean longitude l and its true longitude $\odot$, show that the equation of time is equal to

$$(\quad \odot) \quad (\odot \quad l)$$

4. Define direct and retrograde motion.

5. If V_1 and V_2 are linear velocities of a planet at perihelion and aphelion respectively, then prove that

$$(1 \quad e)V_1 \quad (1 \quad e)V_2$$

where e is the eccentricity.

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